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SCIENTIFIC AMERICAN

FRENCH BATTLEPLANE WITH CELLON-COVERED PLANES PURSUING AN ENEMY AIRCRAFT—THE TRANSPARENT AEROPLANE—[See page 539.]

Vol. CXIII. No. 25
December 18, 1915

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18TH ANNUAL

MOTOR NUMBER

OF THE

SCIENTIFIC AMERICAN

January 1st, 1916

FROM its earliest days the Scientific American has recorded the progress of the motor-driven vehicle. The first account of an automobile appeared in the Scientific American of October 2d, 1845. It described a steam-driven carriage steered by means of reins. Since then every important development of the automobile has been announced in this journal.

At the very dawn of the automobile era, before the public realized the tremendous importance that this type of transportation was soon to assume, the Scientific American began publishing an annual automobile issue devoted to the progress of motor-driven vehicles.

The next annual issue, which is the eighteenth, will contain a vast amount of material that will be invaluable to every motor car owner.

There will be an article on the car of 1916, explaining changes in design and construction that will be prominent in the product of the forthcoming year. Developments in commercial cars will also be covered by a special article, the author of which is a man who has made a close study of motor trucks.

The increasing use of high-speed multiple-cylinder engines makes the article on "Saving the Car by Careful Driving" of particular importance. Handling a car of the new type is very different from that of two or three years ago.

The car of to-day contains so much electrical apparatus that automobile owners will welcome the article on the care of the electric starter and ignition systems. At present, a motorist who may be good at repairing mechanical defects in his engine feels absolutely helpless when any trouble develops in his electrical equipment. Instructions as to the repair and care of this equipment have been prepared by an able engineer who explains everything in very simple terms, with illuminating illustrations.

Henry B. Joy, President of the Lincoln Highway Association, tells very interestingly what has been done toward the completion of this great national highway, describing the scenic beauties along the way and pointing out the benefits that will accrue from this important link joining the Pacific with the Atlantic.

These are but a few of the subjects that will be covered in this number. Following the custom of previous years, the issue will contain charts of gasoline and electric motor cars, both of the pleasure and the commercial type, giving the names of manufacturers and the prices of cars. The material is arranged in such form as to constitute a very valuable price list and reference table for prospective purchasers of motor vehicles.

A colored cover by Howard V. Brown

Price 15 cents **On all newsstands**

SEVENTY-FIRST YEAR

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THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXIII.
NUMBER 25

NEW YORK, DECEMBER 18, 1915

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The Active Gyroscope as a Ship Stabilizer

By Robert G. Skerrett

OF recent years the gyroscope has been adapted to many useful services. It has made it possible to establish a corrective base line, as it were, amid a variety of conflicting motions, and, by reason of this, to insure stability of direction or of plane. To employ a popular simile, the result has been akin to giving the controlling mechanism a firm footing where surrounding conditions were apparently hopelessly otherwise.

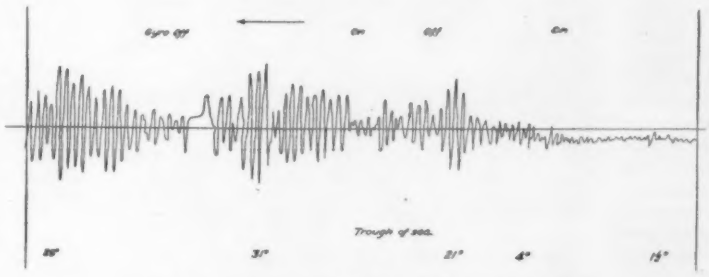
Without anything to hold to, so to speak, with the craft free to tilt in every direction, Mr. Elmer A. Sperry, by means of an ingenious arrangement of gyroscopes, has been able to automatically stabilize the flying machine. Here he has made use of the inherent impulse of the rapidly spinning wheels to bring more potent forces into play, for instance, servo-motors impelled by compressed air. But now he has proved that he can carry this method of steadying rocking bodies still further. In short, he has devised a thoroughly efficient gyroscopic apparatus that alone will be able to deal with the motions of a ship in a seaway. This is so revolutionary in its promise that the temptation to speculate upon the many possible applications is well nigh irresistible. The invention opens up wide vistas of usefulness among ships of war and those of peace.

Recently, Mr. Sperry equipped the little motor yacht "Widgeon" with one of his stabilizers. The vessel has a displacement of only 165 tons and was very much prone to roll freely in a seaway. In fact, she has been said to roll as much as 70 deg., over and back, within a period of something short of five seconds! Up on the Great Lakes, where the "Widgeon" is owned, the comparatively shallow waters are soon worked up by a strong wind into short, deep, and fast-following seas. A yacht such as this one would hardly prove a comfortable craft in those waters except under very favorable circumstances.

The weight of the equipment placed aboard the yacht weighed about one per cent of the displacement of the craft, and for convenience was placed on the upper deck just abaft the smokestack. Mr. Sperry thus describes how the apparatus functioned when put to a severe test:

"A strong wind had been blowing all day, and Government storm warnings were hoisted all along Lake Erie. However, a trip was made from Toledo to Cleveland, in the evening, and when the gyroscope was 'off' the yacht rolled up to 25 deg. each side of the vertical. But with the gyroscope 'on,' this roll was quenched down to an average of three deg. or less. The interesting point about the performance was that the boat steered very much steadier and made her run in as good time as on any previous trip, including calm seas, and while stabilized her decks remained dry."

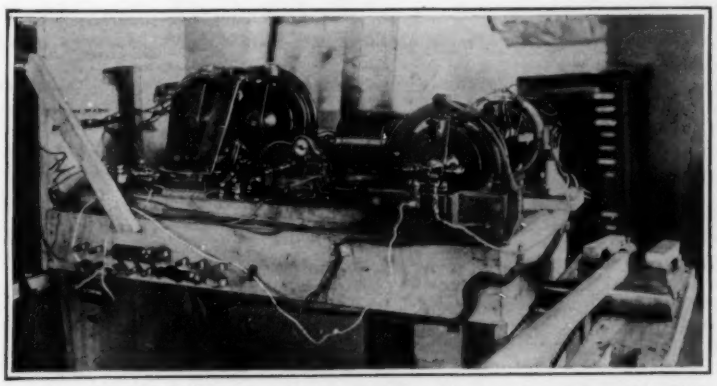
It may not be generally remembered, but about three years ago Mr. Sperry installed aboard of the U. S. S. "Worden," a destroyer of 605 tons displacement, an experimental gyroscopic stabilizer consisting of two quenching units—the twin gyroscopes being placed amidships on the weather deck and well out toward opposite sides. By means of special ballast tanks, it was possible to increase the boat's displacement up to a total of 1,000 tons. This afforded material for progressive tests, and the results were astonishing. The little craft was virtually transformed, and where she had previously rolled heavily the total arc was reduced to a maximum of five deg. in a boisterous seaway. Mr. Sperry accomplished all he set out to do, but the equipment was in some particulars a makeshift and likewise to a considerable degree cumbersome and over weighty.



An actual record of the rolling of the "Widgeon" when the gyroscopic stabilizer was "off" and "on"

The innovation was not welcomed by some of the conservative officials of the naval service: they quite failed to appreciate the principles involved and did not realize that the apparatus could be modified to suit service requirements. Happily, this attitude has changed, and the Navy Department has now ordered three stabilizer equipments for the fleet. Two of these are to be placed aboard submarines and the largest is intended for a naval transport of 10,000 tons, now under construction. The weight for the latter will be in the neighborhood of about eight tenths of one per cent of the ship's total displacement! The reason for this apparent economy is due to the fact, as Mr. Sperry explains it, "that waves of given magnitude belabor small ships more than they do large ones, which is to be expected, and therefore require relatively more roll-quenching power to be fitted."

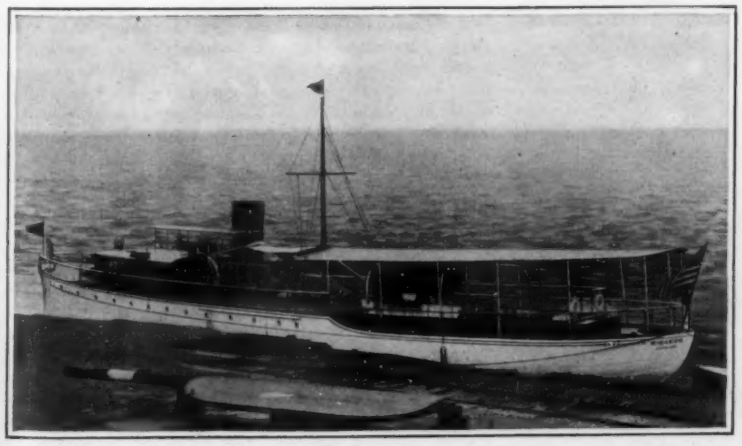
Probably one of the most impressive characteristics of this form of stabilizer is that the apparatus is susceptible of modifications to suit the conditions imposed by the peculiarities of each kind of vessel. That is to say, where limited space is available, or where a certain weight must not be exceeded, or where the power at hand for the spinning of the gyro or gyros is comparatively low, then the form, the weight, and the speed of revolution can be fixed accordingly. Further, it makes substantially no difference where the stabilizer is placed: it may be up on deck or down in the hold, or it may be amidships or forward or aft as convenience dictates, but wherever placed and once at work or "on," as it is technically expressed, the craft is steadied and held within certain limits of roll no matter how the seas may be tumbling.



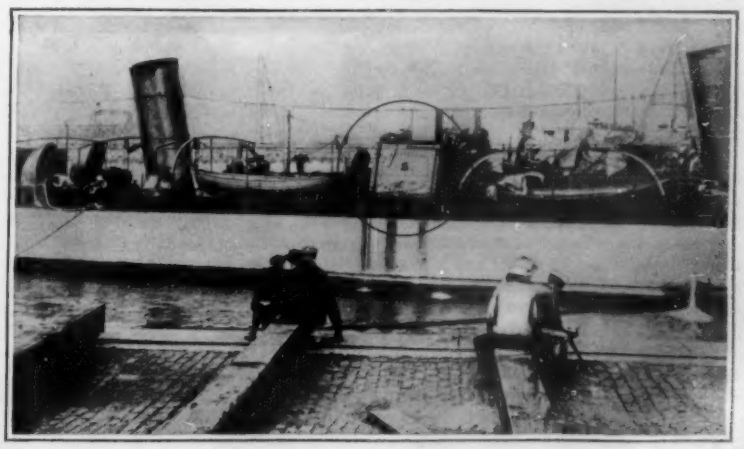
Model gyroscopic stabilizer for a 30,000-ton ship. The two gyroscopes on the right exercise control over the two on the left. The control gyroscopes are full-sized, while the stabilizers are only big enough to quench the rocking motion of the platform on which they are mounted

The reason for placing the stabilizers aboard two of the submarines is to try to make those boats more habitable when running on the surface. During some of our war games of late, life aboard these vessels has been well nigh unendurable when the boats have been traveling on the surface. They have rolled very deeply and very rapidly; in one case, as a young officer put it, "She went over and over and over until we thought she would turn turtle and then back she jumped as far on the other side. We were kept sitting alternately on top of the cylinders of the opposite engines." Again, in the case of another submarine, she covered a total arc of 1,800 deg. a minute, and her swing from side to side was in the very brief span of a trifle over four seconds! Ceaseless motion of this sort,

(Concluded on page 547)



Yacht "Widgeon" of Cleveland, showing the mounting of the gyroscopic stabilizer on the upper deck immediately abaft the smokestack



U. S. S. torpedo-boat "Worden" which was experimentally equipped with the gyroscopic stabilizer. S is one of the two gyroscopes within its shelter

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The President On Our Merchant Marine

THE statement in the presidential message that the present Congress will be asked to consider a bill for the betterment of our merchant marine, has stimulated interest in this most vital national problem. That the bill contemplates government purchase, ownership and operation may be discouraging to those of us who were opposed to the abortive measure of a generally similar character, which was introduced in the last Congress; but we understand that the bill, as drawn up by the Secretary of the Treasury, avoids the pitfalls which brought the former measure to grief, notably in respect of the purchase of interned ships of the belligerent powers, and that Mr. McAdoo is sanguine that the proposal, in its new form, will commend itself to Congress and the country at large. The funds for the purchase of the ships are to be secured by an issue of bonds, and it is the intention to substitute private for public ownership, when the scheme shall have reached the stage of successful operation. Although, we are opposed to the principal of Federal competition with private enterprise, it is only fair that criticism should be reserved until the full details of the Administration's plans are made public.

It is now pretty well understood that the problem is a difficult and intricate one, and there is no short cut through the many opposing interests and principles involved which would lead to an easy solution. The only point upon which every one seems to agree is that something ought to be done and done quickly. If the country is to avail itself of the unparalleled opportunity for the resuscitation of our merchant marine and the establishment of our fleets upon all the seven seas, which is afforded by the commercial crisis resulting from the Great World's War.

The greatest difficulty (and it is one from which there seems to be no escape) is the high price of labor in this country. To a certain extent, it affects the cost of ship construction, but to a far greater extent it affects the cost of operation once the ship is built and put into commission. Formerly, it was believed that if an American ship owner were permitted to go into the open market and purchase his ships wherever he pleased, and operate them under the American flag, the problem would be solved; and a clause was inserted in the Panama Canal Act of a few years ago which removed the embargo and made it possible to try the great experiment. The results, contrary to all expectations (except among the shipping men themselves who understood the real situation), were pitifully small, and very few ship owners have availed themselves of the opportunity thus offered. The fact of the matter is, that the Canal Act covered only the lesser of the difficulties under which American shipping labors, namely, the somewhat greater cost of construction in this country, while it failed utterly to provide any remedy for the higher cost of operation.

The great success which has attended the efforts of some of the leading maritime nations to build up their merchant marine by means of judicious subsidies, suggests that the solution of the problem by the United States will be found in the same direction. Unfortunately, for want of an intelligent appreciation of the true economic principles upon which subsidizing is founded, the American people seem to be unalterably opposed to the granting of subsidies. It is to be feared that this opposition is one of many evidences of a popular and unreasoning prejudice against those large and successful corporations which have done so much to promote the industry and multiply the general wealth of the United States. A little less of prejudice and a little more of thoughtful study of the question should show that the economic principles which recognize the wisdom of instituting a tariff for the protection of young industries might very well be applied in promoting the early growth of our merchant marine by a moderate and well-regulated system of subsidy. A judicious tariff has served as the cradle of many new industries in this country, which tariff, as the industries attain their lusty growth, was subsequently reduced and ultimately eliminated altogether. There is every reason to believe that like causes would produce like results in respect of our merchant marine, and that, with the multiplication of ship yards and the creation of a numerous fleet, the time would come when our shipping trade, as thus firmly established, would be self-supporting and quite independent of further government assistance.

The Problem of the Panama Canal Slides

SOME two years ago, when the slides of the Culebra cut had developed one of their periodic revivals of activity, Colonel Goethals remarked to the writer that the problem of the slides was "merely a matter of digging and patience." Were it not for the magnitude of these earth movements, they would have attracted but little attention; for they differ only in size from the slides which occur by the hundred whenever the construction of new railroads necessitates the opening up of cuttings through undulating or mountainous country. In fact, it may be said that the construction of the whole Panama Canal, except for the magnitude of the work, has presented no problems which do not regularly recur in the routine work of the civil engineer.

As we have frequently explained in this journal, it is the great depth of the cutting through the Culebra divide, coupled with the unstable character of the material through which it has been made, that has caused all the trouble. The crushing and sliding movements, covering the whole period of the canal construction, have culminated in the recent disaster, when the bank on each side of the cut for a distance of over two thousand feet and for a combined width of more than that distance moved bodily into the canal, completely filling the prism from bank to bank.

Now, there is nothing hidden, mysterious or unexplained in all this—the enormous earth movements are simply a dramatic evidence, on a vast scale, of the fact that the laws of gravitation are immutable, and that if man disturbs the equilibrium of nature he must pay the penalty until she has readjusted herself to the new, man-made conditions.

Geologically considered the Isthmus of Panama is very young; and geologically speaking, we may say that only yesterday the Isthmus was under water and was represented by a deep mass of marine-deposited silt, which, after the Isthmus was formed by volcanic upheaval, gradually dried out until it formed the immature and semi-solid, so-called rock, through which so large a part of the canal has been excavated.

When the United States took over the Panama Canal from the French, the survey of our engineers led them to believe (and in this they were endorsed by the French engineers) that as the cutting of the canal progressed and the lower depths were reached, the material would prove to be sufficiently cohesive to stand the load of the lofty banks on either side, and that these banks would be stable at an inclination of about two to one. The event has proved that they were wrong; for the toe of the banks has crushed and yielded to the enormous superincumbent mass, reaching to three and four hundred feet in vertical height, and the cohesion or frictional resistance of the material in other cases has not proved sufficient to prevent the banks from breaking away far back from the axis of the canal and sliding bodily into the cut.

It has been suggested that if a very elaborate survey by boring had been made before the work was commenced, the result would have turned out differently. But would it? Let us suppose that such a survey had been made and the tests made to determine its crushing strength, resistance to cleavage, etc., and that the survey had disclosed the position and slopes of the inclined strata of greasy material, which have contributed so largely to the slides—it is questionable if the physical conditions of the canal would be different from what they are to-day. Probably the slides would have come down, pretty much as they have done, and the only advantage of such a survey would have been that the country would have known that the trouble was coming and would have been spared the many disappointments which have marked the construction of the canal.

For this reason, it is difficult to understand just exactly what the commission of geologists, meteorologists, seismologists, etc., which is to visit the Isthmus and look into the problem of the slides will be able to accomplish. The thing has happened. Ten million cubic yards of material have moved into the cut, or will do so before the cut is clear. All this has happened in accordance with an inexorable law which neither this commission or any other, however expert, can arrest.

As we see it, the problem is not one for the geologist, not even for the engineer, but for the shovel. It can be solved in one way only, and that is by patient digging with the giant dredge; and the country may rest assured that Colonel Goethals will crowd as many of these against the face of the slides as can effectively be set to work.

Preparedness and the Schoolboy

IT is true, and it is significant, that any system, cult, belief or practice which is even to approach a wide measure of acceptance must be ingrained primarily in the mind of the up-coming man or woman. Suffrage, whether on parade or in campaign, has always more or less of this younger element about it, an ally desirable and strong in its enthusiasm, freshness and very youth. A new party springs up, and its ranks are filled by younger men who have the power and eagerness to bring about accomplishment, often where older heads might sense neither success nor the advisability of fight; and it is not surprising that this newly-conceived *preparedness*, for a future, if not indeed a present, very real deficiency in our national make-up, embraces, first, this country's great prospective asset, the schoolboy.

A few years ago, and things military were quite willingly consigned to West Point, Annapolis, a few universities and the so-called military schools; some of these latter, by virtue of exceptional standing, being dignified by the War Department with the term "Distinguished Institution." The military schools enjoyed an increasing vogue, and gradually such work found a place in a growing number of the colleges, where from a frequently disliked first-year "extra," to be taken if necessary, to be avoided if possible, it came to prove its worth and find its present place. The military schools deserve much credit for the efficiency which characterized their work and popularized this mode of training; for at the present time there are 102 institutions of different rank in this country having well-drilled corps of uniformed cadets, with military instruction compulsory for all physically fit students during a period of at least two years, with not less than 84 hours for each academic year. Officers of the United States Army are detailed as professors of military science and tactics at each of these 64 universities, 32 military schools and 6 separate institutions of academic grade. For 1915 there are ten Distinguished Institutions among the universities, and an equal number from the military schools.

Anyone need not be an alarmist to perceive the advantage of such splendidly constructive work as this; and the conscientious pacifist must know the good to come from proper discipline which is competently outlined and wisely administered. This official co-operation is available for all educational institutions under certain conditions which are not difficult to meet, and in several cities they have been met, quite recently, by public high schools. For such work to be successful it is very essential that the boys themselves show the fullest interest in it, for in these schools such training cannot well be compulsory. This interest, however, has nowhere been lacking. Perhaps the Scouts and Boys' Brigade have helped to this, the one with roughing-it and out-of-doors ideals, the other with the manifest advantage of military discipline and the systematic whipping-into-shape of the whole boy which such training renders possible. The benefit of one and the practical value of the other have caused both to grow with the times, and the Boy Scouts of America reported some time ago an active organization of 6,000 Scoutmasters and 300,000 boys. It is probable that this is exceeded now. The last information obtainable as to the strength of the United Boys' Brigade showed them with 30,000 affiliated bodies of 10 to 100 boys each. These boys are nearly all of common-school age, and when they enter the high schools they are excellent material for the work the latter are just beginning.

The other day one of the papers in an eastern city (Baltimore) carried a notice of an approaching football game which would conclude the season for two rival high school teams. The article mentioned as an added feature a drill to be given before the game by the cadet corps of these two schools, two bodies of young men which had been organized about a month. During that time they had been drilled for two afternoons each week by a Lieutenant from the United States Army, and their first competitive drill consisted of some simple field maneuvers and close formation work, executed with rivalries as keen as those between the teams. The drill was so good that some officers of the National Guard, who saw it, afterward declared that they could not accomplish as much in several months, with men, as had these high school boys in but a few weeks.

This discipline, which teaches individuals to act as a unit subject to one command, and under a reasonable degree of restraint, will bear good fruit, and it is to be commended. Though the training of boys not yet at maturity is not the system of Europe, it is one very constructive step here, and one that is encouraging, moreover, in days of much conflicting agitation and half-acknowledged fears. Preparedness by and for this nation must be met, and the schoolboy is helping to point the way.

Automobile Notes

Builds Garage of License Tags.—One of the oddest garages in the country is being planned by a Connecticut garage owner. He has obtained from the State department several thousand old license tags, for which the State could find no use, and has designed a garage which will be built entirely out of those tags. Aside from the advertising value of the odd-looking building, the owner expects it to give just as good service as any of the "sheet iron" garages erected in the country.

War-Auto in the 15th Century.—Among the interesting documents in the old Bohemian city Saaz, on the Eger river, is a picture showing an attack on the fortress Glatz, in Silesia, in which war-automobiles were used! The mechanically-driven cars were flat vehicles, protected by huge shields in front, in which the soldiers turned large cranks, the rotary motion of which was transferred to cog-wheels and to the road wheels. These 15th century "chauffeurs" got a speed of 4 miles an hour out of the armored cars.

France Sells Used War Trucks.—The French government last month disposed of 740 motor trucks, used in the war since August, 1914, at public auction. The trucks were originally fitted with motorbus bodies and were running on the streets of Paris. At mobilization they were commandeered and have been used in transporting meat and other provisions. New French-made chassis have taken their places and the government sold the old trucks. Hereafter all imported trucks will be "run to destruction" and then replaced by domestic product. France announces its intention of using no further imported trucks in the war.

Swiss Will Subsidize Motor Trucks.—After a thorough study of the effects of the subsidy systems of the French and German governments, as applied to motor trucks, the Swiss military authorities have come to the conclusion that these systems are the only reliable and sensible solution of transportation problems in time of war. Uniform chassis construction, uniform accessories and parts, and a complete transportation organization are planned. The sum of 2,000 francs is to be given to the purchaser of a truck at the time of the purchase, and a yearly sum of 1,000 francs during the succeeding four years.

Germany Forbids Benzol Contracts.—Following the issuance of an order determining the highest prices to be demanded from automobile owners for benzol, the German government has now issued a second order forbidding the manufacturers of benzol to demand contracts for definite terms over a period of time exceeding the duration of the war. It has been discovered that certain manufacturers, seeing little profit in the selling of benzol at the prices set by the authorities, determined to obtain profits through long time contracts at this maximum price. Under such conditions the motorist would be compelled to take benzol at the war-price even after peace had been concluded. Such machinations are frowned upon by the German government.

Balancing High-Speed Wheels.—Attention has been called by a British motorist to an entirely neglected feature of light car construction. When the wheel of a light car, cycle car or motorcycle is revolving 370 to 400 times a minute—as at road speeds of 30-32 miles an hour—the rim of each wheel is traveling at what steam engineers call "high speed." At this speed the weight of the tire valve is quite appreciable and makes itself known in excessive vibration of the wheel. In order to counteract this effect the motorist placed a lead strip of the same weight as the valve on the rim exactly opposite the valve position. The result was highly satisfactory, for all vibration stopped. Where the wheels are of wood, a couple of screws can be inserted, instead of the lead strip, or copper rivets in wire wheels. On the other hand, a motorist who fitted a special valve bolt of greater weight to his cycle car, became greatly worried when the whole car developed excessive vibration, due solely to the extra "out of balance" weight.

British Motor Parts Duty Faces Difficulty.—The 33⅓ per cent duty to be levied on all imported pleasure motor cars and their parts is already causing many difficulties in Great Britain. There are a great many manufacturers in the United States making a specialty of turning out crankshafts, connecting rods and similar motor parts which may with equal facility be used in marine, stationary and truck chassis, as in pleasure cars. Drop forgings amounting to more than half a million separate pieces have been ordered by one large British firm in the United States, and about 95 per cent of this total is for "government use." The importing firm, as well as the American manufacturers, are greatly worried as to how the government will discriminate between "pleasure car parts" and "commercial car parts"—the difference amounting to several million dollars in import duties. Other assemblers in Great Britain are in a similar position and attempts are to be made to rescind the order including "component parts" of pleasure cars in the import duty.

Science

Richard L. Garner, who attracted so much attention twenty-odd years ago by his studies of the "language" of the anthropoid apes, has undertaken to secure moving pictures of the same animals (especially the gorilla and the chimpanzee) in Africa. He will also obtain motion pictures of other forms of African life, human included.

A Glass-making Research Department has been established in connection with Sheffield (Eng.) University, with classes at the university and at four neighboring towns. The result, according to *Commerce Reports*, is that 8,000 Yorkshire glassworkers, who, before the war, were turning out only cheap glass bottles, are taking up fine glass production.

Nematodes.—The worms known as nematodes have recently been the subject of astonishing revelations, and the wonder grows daily. Dr. N. A. Cobb, an authority on this group of animals, declares that there must be hundreds of thousands of species of nematodes, over nine tenths of which are still unknown to science. Of the parasitic nematodes infesting vertebrate animals alone it is estimated that there are at least 80,000 species. Insects, mollusks, crustaceans, and other animal groups are also much infested, and as a rule a given species of nematode is peculiar to a single species of host. Lastly, the species of nematode living free in soil and water vastly outnumber the parasitic species. As these creatures are enormously prolific, the number of individuals must be quite beyond conception. Dr. Cobb estimates that in the upper foot of an arable soil the number of nematodes runs to thousands of millions per acre.

Drug Plant Investigations.—The U. S. Bureau of Plant Industry has carried on for a number of years experiments designed to ensure better methods of cultivating and utilizing drug plants, and noteworthy results have recently been recorded. About 150 species of drug and related plants are now under experimental culture on heavy clay at Arlington Farm and on sandy loam near Glen Dale, Md. At Arlington permanent plantings are being made, which will furnish material, now badly needed, for standardizing crude drugs. One important line of inquiry is in regard to the relation of special feeding to the development of the active principles in medicinal plants. A new strain of belladonna has been obtained by the Bureau through breeding and selection which has a greatly increased alkaloidal content and points the way to a notable improvement in the quality of this drug now found on the market.

Discoveries in Hudson Bay.—Although brief notes have appeared from time to time in the geographical journals regarding the discoveries made by Mr. R. J. Flaherty in Hudson Bay, a detailed account of them has only recently appeared. The first expedition, begun in August, 1910, lasted seven months. In the course of this expedition the explorer gathered information from the Eskimos leading to the belief that the Belcher Islands, shown on existing charts as two groups of small islets north of James Bay, are really extensive islands, and his two subsequent expeditions were made partly for the purpose of verifying this belief. The first attempt was unsuccessful, the explorer being driven about for three months in a small boat at the mercy of storms. In August, 1913, Mr. Flaherty set out from St. John's and wintered in Baffin Land, whence he sent his vessel home. In August, 1914, the voyage was resumed, and after many difficulties the Belcher Islands were reached. It appears that the largest island is over 00 miles long, and the total area of the chain, extending from 55 deg. to 60 deg. N., is estimated at 4,000 miles. Hence material alterations are necessary in our maps of Hudson Bay.

An Important African Railway.—Once more geographers must take out their maps of Africa and trace thereon the course of a new railway. This line, which will be of immense importance in time of peace, was constructed with remarkable speed primarily for the purpose of facilitating the invasion of German Southwest Africa by the troops under Gen. Botha. It connects the railway systems of Southwest Africa and the Union of South Africa, extending 300 miles from Kalkfontein in the former to Prieska (on the Orange River) in the latter. According to the *Geographical Journal*, rails were laid from Prieska to a point on the Orange River opposite Upington between September 7th and November 20th, 1914. Progress was delayed from the latter date until the end of last March, after which the work was pushed rapidly forward and completed June 25. A glance at the map shows that the new line saves many hundred miles of travel between points in South Africa and those in Southwest Africa, as compared with the old route by rail to Cape Town and thence by boat to the ports of the late German colony, now under the military control of the British. Through trains are now running from South African points to Walfisch Bay.

Electricity

Available Water-Power of the United States.—According to the *Electrical World*, the available water-power of the United States, excluding Alaska, amounts to more than 28,000,000 horse-power, of which approximately 7,000,000 or 25 per cent has been developed.

Rules for X-Ray Operators.—A set of rules or recommendations for the protection of Roentgen operators from the dangers attending the use of X-rays has recently been formulated by the Roentgen Society of London. It is announced that these will be issued at an early date in card form.

Minor Surgery with a Pocket Flashlamp.—To locate a splinter under the finger nail is often difficult. By placing the fleshy part of the finger against the lens of a pocket flashlight, according to the *Electrical World*, in a dark room, the splinter can be plainly seen through the nail almost as if it were under the X-ray.

Huge Electric Siren.—There was used in announcing the official opening of the Panama-Pacific International Exposition an electric siren which is said to be the largest in the world. Its blast can be heard for a distance of 10 miles, and it is driven by a three-phase, 200-volt, five-horse-power motor. The siren has been in constant use at the Exposition for announcing important events such as aeroplane flights, military drills, marine pageants and for other similar functions.

Inspection Lamps for Shells.—A British electrical manufacturer has designed an electric lamp for facilitating the inspection of the interior walls of shells in munition works. The equipment may be described as a tubular lamp protected by a wire guard, a long metal rod, a wooden handle in which is a push-button switch, and a connecting cord and plug. The equipment is held by the handle while the lamp, supported on the long brass tube, is lowered into the shell to be inspected.

Anti-Zeppelin Lamp Shades.—When the regulations for reduced lighting were first put into effect in England as a precaution against airship raids, lamps were shielded with improvised shades. However, since the war is now coming to be looked upon as a permanent state of things, for some time to come at least, there have appeared in that country electric lamp shades especially intended for the purpose. The anti-Zeppelin shades consist of a wire framework covered with an attractive fabric. One of the most popular designs is of the screen pattern; that is to say, it only screens the lamp on the side facing a window. The base of the lamp, in passing through a ring formed by the wire framework, holds the shade in place.

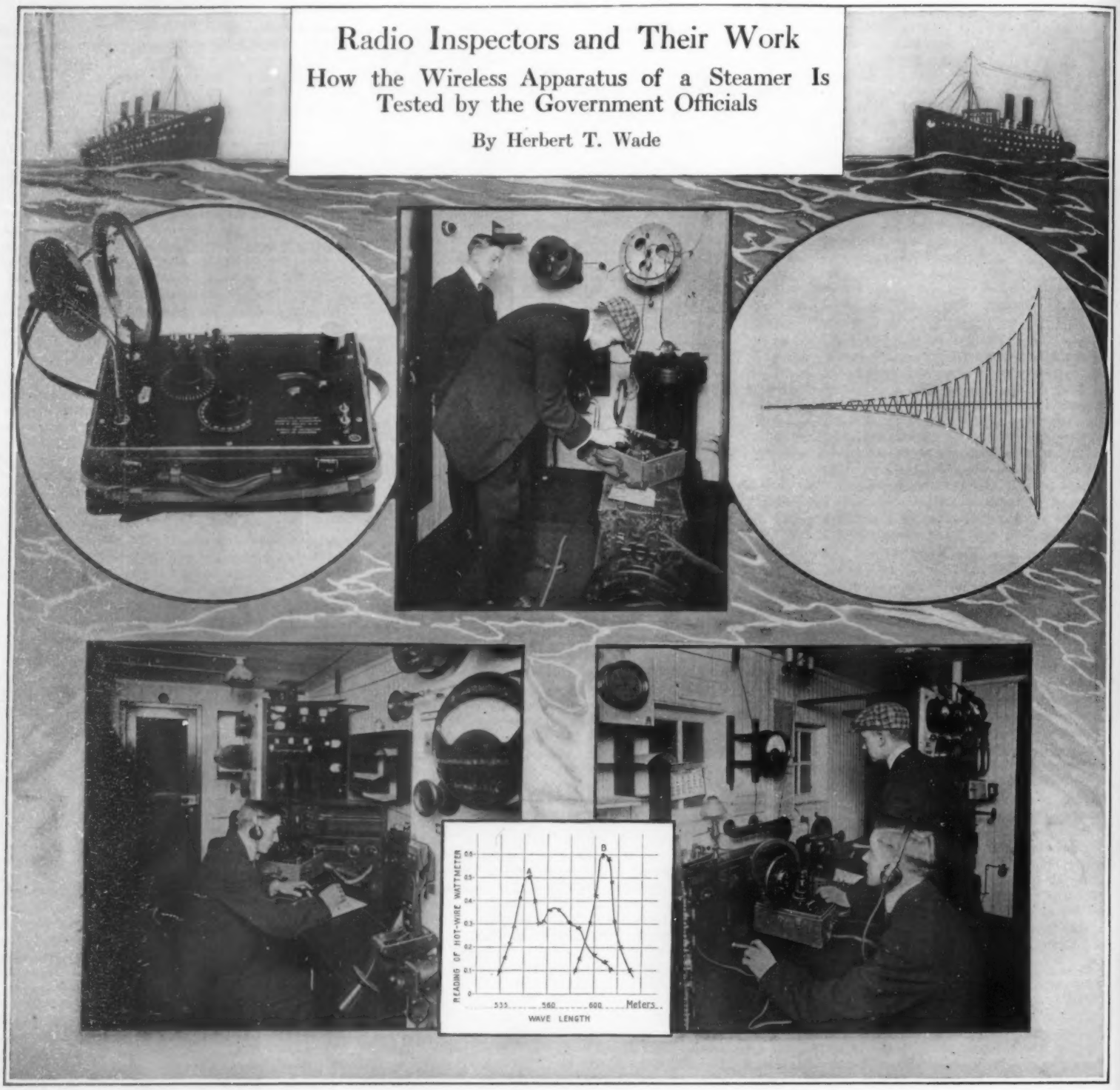
Scarcity of Platinum and the Electrical Industry.—Owing to the growing scarcity of platinum due to the European war, the heaviest of metals is being replaced in many electrical appliances. Formerly, platinum was employed for the lead-in wires in electric incandescent lamps, but at present wires made of nickel-chromium, metallic tungsten or metallic molybdenum are being employed with good results. Metallic molybdenum has also replaced platinum which was liberally used for the resistance wires of electric furnaces in ante bellum days. Platinum was formerly employed for the ignition points of spark plugs, but the greatly increased cost of the metal has compelled the use of substitutes, chief among which is metallic tungsten.

Direct-Current Meters and Stray Magnetic Fields.—Recent tests made by the Metropolitan Electric Company of Reading, Pa., in connection with direct-current meters and stray magnetic fields, are of interest to the electrical profession. While it has long been known that stray magnetic fields affect the accuracy of these meters, the exact extent of the troublesome influence has been a matter of conjecture. The tests indicated that a cable carrying 600 amperes 12 inches away from the meter affected the accuracy of the latter 50 per cent on light, or one tenth, load. The direction of the current determined whether the meter ran fast or slow, while it was learned that the relative position of the meter and cable were important factors, since the same cable when placed only two inches distant, but with the current flowing in the opposite direction, had no appreciable influence on the meter. In another instance a 300-ampere direct-current meter would not register lower than 50 amperes when placed within the magnetic field of a conductor. It was also learned that meters may be influenced by their own leads as well as by adjacent meters; with three meters placed side by side, 12 inches between centers, the precision of the middle meter was found to be altered from 5 to 10 per cent on one tenth load when either of the neighboring meters was carrying full load. As a result of the tests, it is suggested that meters be so installed that the wiring does not encircle them, and that if they must be mounted near together, a distance of at least 15 inches be left between the instruments. Further, meters should never be placed near iron risers. Preferably, the leads should run into the meter in a horizontal manner from the left hand side.

Radio Inspectors and Their Work

How the Wireless Apparatus of a Steamer Is Tested by the Government Officials

By Herbert T. Wade



Radio inspector testing the equipment of a steamer; the portable instrument used in the work, and graphic presentations of wave forms

Top row: Portable Kolster decremeter used by the radio inspectors for testing wireless transmitters; radio inspector measuring the wave sent out by a wireless transmitter; a wave train with a logarithmic decrement of 0.2. Bottom row: Operator's desk in the wireless room of the steamship "Pastores"; resonance curves obtained by Inspector of Department of Commerce Radio Service; radio inspector watching the ammeter of a ship station transmitter to determine amount of current flowing into the antenna

GENERALLY speaking, wireless equipment is required by law for deep sea and large lake passenger steamers, and it must conform to such regulations as the governments may impose in view of international treaties and national conditions. In the United States an act of Congress places the supervision of all wireless communications at sea between sea and shore, and the control of various land stations, except those of the Army and Navy, in the hands of the Secretary of Commerce, who issues or refuses the necessary licenses and permits, and prescribes or modifies the regulations which are based on laws adopted by Congress. War conditions naturally change the ordinary operations of shore and ship stations, as may be seen in the operation of the German stations at Sayville and Tuckerton by the Government. The requirements of the act, approved July 23rd, 1912, amending the original act of June 24th, 1910, provided that all passenger steamers carrying 50 or more persons either sailing under the American flag or touching at American ports, must be equipped with apparatus for radio-communication which shall be instantly available in case of emergency. In fact, one of the rules governing ship and land radio-stations provides that the transmitting apparatus when operated from the emergency power supply should be capable of functioning within two minutes after unexpected notice to the operator, and there must be provided an independent electric power source which will enable radio messages to be sent for at least four hours over a distance of not less than 100 miles, day or night, from a ship station.

The International Radio Telegraph convention held in London, April, 1912, provided for two standard wave lengths, one of 600 meters and the other of 300 meters, authorized for general public service; and every station, both coastal and on shipboard, must be equipped to send and receive such wave lengths, though vessels of small tonnage which are unable to use a wave length of 600 meters for transmission may be authorized to employ exclusively a wave length of 300. Six hundred meters is specified as the normal wave length for all other ships.

This brings up the interesting question as to the wave lengths used in general traffic. Ordinarily, most of the traffic at sea is handled with the normal wave length of 600 meters, and the operator is constantly listening with his apparatus tuned to such a wave length. As a result there is a maximum amount of interference, and while this adds to safety, it does not promote facility in the exchange of messages such as would be obtained if different stations used different wave lengths. Of course, there are certain ships and coast stations which, after listening for the 600-meter wave length and establishing the indentity of the calling station, can tune their instruments to some other mutually agreed upon wave length, and eventually this will be the procedure demanded for the interchange of business, so as to reduce the confusion caused by interference. At the present time, however, it is estimated that 95 per cent of all traffic at sea is handled on the 600-meter wave length, and it is for this reason that when a wireless distress signal is sent out every ship within range "listening in" is able to pick up the call.

The Bureau of Navigation of the Department of Commerce, through its radio inspection service, is directly concerned with the enforcement of these regulations. The Secretary of Commerce issues the necessary licenses and permits, without which neither land nor sea stations can operate, and provides for the examination of operators, the control of radio communication generally, and the inspection of various stations both on land and on sea, to see that they respect the regulations and statutes.

The United States Government considers that it is as necessary to inspect the radio communication equipment of ships as it is to supervise boilers or hulls, and this work is carried on by a number of radio inspectors who examine the various stations and determine

whether or not they comply with the regulations. As a result of the activity of this department, the standard of wireless equipment of American merchant vessels has been steadily raised so that to-day, with the possible exception of the German merchant marine, the ships of the United States have better and more effective instruments for wireless than those of any European nation. Indeed, over 100 sets of apparatus on American ships are now in course of replacement by a single company with instruments of more modern design and far greater efficiency, and when this is accomplished the average American vessel will be superior even to the German.

Much has been done by the inspectors in an advisory capacity by pointing out to owners the desirability of good equipment and indicating how it can be secured and operated. Then again, the inspection is of great advantage to the owners and officers of the vessel, for in many cases wireless operators are not sufficiently skilled to determine whether their apparatus is working at its greatest efficiency and range, and as a result of inspection the equipment is made far more useful.

To facilitate inspection, Mr. F. A. Kolster, physicist in charge of the laboratory of radio communication of the United States Bureau of Standards at Washington, devised a direct-reading portable instrument which recently has been recognized by the award of a gold medal at the Panama-Pacific Exposition.

(*Concluded on page 546*)

Boys Organize to Build Better Roads

AT the present moment, when the agitation for the building of permanent highways is at the highest pitch in the history of road building, the example which has been set by Mansfield, Mo., a town of 500 population, situated near the heart of the Ozark mountains, is well worth emulation in the hundreds of small communities which are grappling with various phases of the good roads problem. So far as is known, Mansfield, which has as its slogan, "The Gem City of the Ozarks," is the only town that can lay claim to a worth-while boys' good roads club. It is this club that is doing great things and thereby winning fame for the town because of its good roads work.

Dr. F. H. Riley, mayor of the town and one of the three road commissioners, organized the boys' club during the summer as a means of inspiring others to become interested in the building of permanent roads into the county seat of Webster county. More than 50 boys took part in the first attempt at road making early in August, and more than equaled any previous road building efforts on the part of the men of the community. The stores and business houses declared a holiday, and many of the older men accompanied the boys into the country to assist in the work. Road building sentiment reached a feverish pitch for many miles in all directions from Mansfield, and the farmers vied with the business men and boys in improving the main traveled roads into the county seat. The town voted an issue of $20,000 in bonds for the continuation of the good roads work along permanent lines by a three to one majority, and within a year it is expected that the 35 miles of road in the Mansfield special road district will be as well improved as any county system of highways in Missouri.

In September the boys' club made a second trip into the country and gave the good roads cause an impetus such as it has received but few times in recent years. Next spring the club will resume its work along more ambitious lines and an effort will be made to increase the membership to 100. When the club went out into the country for the first day's work, many of the business men and older men of the community took picks and shovels and joined Dr. Riley's club as associate members. They did their work with as much enthusiasm as the boys. The boys picked and hauled more than 200 loads of rock which were used in resurfacing bad spots in the roads and in building a concrete culvert. Eight or ten teams were put to work hauling gravel from nearby mines, with the result that a permanent road was built in a day's time.

Dr. Riley believes the next generation of business men in Mansfield will be good roads boosters of the most advanced type, as the result of the work being done by the boys' club. The men of the town expect that the good roads problem will be settled definitely by the time their sons have completed their education in the building of permanent roads. This belief has been communicated to other towns in the Ozark country and next year several boys' good roads clubs will be at work.

Boy members of a good roads club at work near Mansfield, Missouri

Boy road builders who have been reinforced by farmers and business men in carrying out their work

Model Manure Bin for Limiting Breeding of Flies

MEDICAL science has proved the house fly to transmit to humankind the germs of tuberculosis, typhoid fever, scarlet fever, the dysenteries, cholera, tetanus, eye contagions, anthrax, glanders, infantile paralysis, diphtheria, meningitis, leprosy, bubonic plague, carbuncle, infectious wounds, erysipelas, and the eggs of parasitic worms. Although flies breed in pig and chicken manure, in ensilage, moist bran, rotting potatoes, garbage, in refuse and in the decaying, fermenting matter on the public dumps of towns and cities, 95 per cent of flies are bred in horse manure.

One way of controlling such breeding is to keep the manure in a fly-tight bin or pit, so that mother flies will not find therein a lying-in chamber. A bin or pit of the required size may be built in or alongside the stable, the cleanings of which are thrown into the pit the first thing every morning; after which the pit is kept closed tight except when manure is taken from it. There should, in addition, be water-tight stable floors, to be cleansed thoroughly every day.

The method just mentioned is advocated by R. H. Hutchison, Esq., Scientific Assistant to the Bureau of Entomology at Washington, D. C. It is especially appropriate in cities where frequent—twice a week, certainly weekly removals, because the development from egg to full-fledged fly takes about 10 days—removals of manure from the city can be ordinanced; combined with modern sewage and garbage disposal, this procedure should go far to nullify the house fly menace to the communal health and comfort.

Maggot trap in use at the Maryland Agricultural College

Another method of controlling flies is by the use of a maggot trap for the handling of manure. The maggots tend to migrate, crawling away from the manure (especially moist manure) in search of comparatively dry and safe places wherein to pass the pupal or resting stage. If the manure be placed on a slatted platform, and if the platform stand on the floor of a concrete basin containing ½ inch or more of water, the larvae in migrating will drop into the water and be drowned. Each day the stable cleanings should be placed on the platform, compactly heaped, and well moistened, in the way presently to be stated.

Manure is best kept wet by having a small cistern close to the platform and a pump so placed that the watering of the heap is readily accomplished. If the liquid manure from the stable is conducted by drain to the cistern, the valuable plant food which it contains will then be added to the manure on the maggot trap. Such a trap will destroy 99 per cent of the maggots developed in the manure. After the manure has been standing on the trap ten days it will be practically maggot-free and can then be used on fields or in gardens, or stored in heaps without likelihood of further fly-breeding in it.

The maggot trap is cheap, requires little extra labor to operate it and dispose of the drowned maggots, and tends rather to preserve than to lessen the value of the manure. Here, as with all other methods, careful attention must be given to breeding places other than horse manure.

A third method is the chemical treatment of manure by which the maggots feeding therein are poisoned. For this purpose powdered hellebore and powdered borax are probably the best. The hellebore is added to water at the rate of ½ pound per 10 gallons; after stirring, this mixture is allowed to stand for 24 hours, when it is applied to the manure at the rate of 10 gallons for every eight bushels (about 10 cubic feet). Applied thus, hellebore kills from 85 to 98 per cent of the larvæ, does not alter the composition of the manure, nor hinder the normal activity of the bacteria, and has no injurious effect on plants when the manure treated in this way is added to the soil.

Powdered borax is applied in solution at the rate of one pound dissolved in not over 12 gallons of water, to every 12 bushels (15 cubic feet) of manure; and will destroy from 90 to 99 per cent of the maggots. The powder should be added to the water and stirred until all is in solution. Great care must be used in treating manure with this substance, because large applications to the soil are likely to injure plants. Ordinary crops will not be injured when the manure is treated at the rate of not more than one pound per 16 cubic feet, and when not more than 15 tons of manure thus treated is applied to the acre. Borax can be used freely on all breeding material, such as refuse piles and privies; but hellebore is perhaps safer for treating manure, while borax is better for the treatment of stable floors and the like, because hellebore decomposes after 25 to 30 days. The manure produced by one horse per day amounts to from one and one half to two bushels; the volume of cow manure is somewhat less. It would therefore require for the treatment of either horse or cow droppings between one to two gallons of the stock solution of either borax or hellebore. It should cost six to eight cents per day per animal for borax treatment, and nine to twelve cents the day for the hellebore treatment.

Strategic Moves of the War, December 11th, 1915

By Our Military Expert

FOR a composite battle-front occupied by something like 26,000,000 men under arms, the quiet and comparative paucity of news and activity seem a trifle ominous. The general situation remains practically unchanged since last week's discussion, although there are faint rumblings which seem to presage an eruption of major operations in the near future.

The lines of the Central Empires in the Balkans have moved on a little farther, their slow progress being necessitated by the geographical difficulties which distinguish this theater of war—the lack of roads suited to the movement of artillery and supply transportation and the almost complete absence of railways. Besides, the Serbian and Montenegrin forces which opposed the Teutonic advance in the north seem to have split—or have been split—into detachments which seek to engage in a legitimate sort of guerrilla warfare among the peaks and passes instead of remaining as a comparasecrecy, it is reasonably deducible that promised assistance from Italy in the twin matters of troops and supplies has at last developed to a certain extent. Several vessels laden with munitions have been sunk by Austrian ships at S. Giovanni di Medua, one of the few landing places on the Albanian coast from which practicable roads of any importance lead to the interior. Roads from this place extend to Scutari, twenty miles to the northward, and to the small town of Gomsitche, south of the river Drin, whence the way proceeds to Prisrend, well behind the invading line.

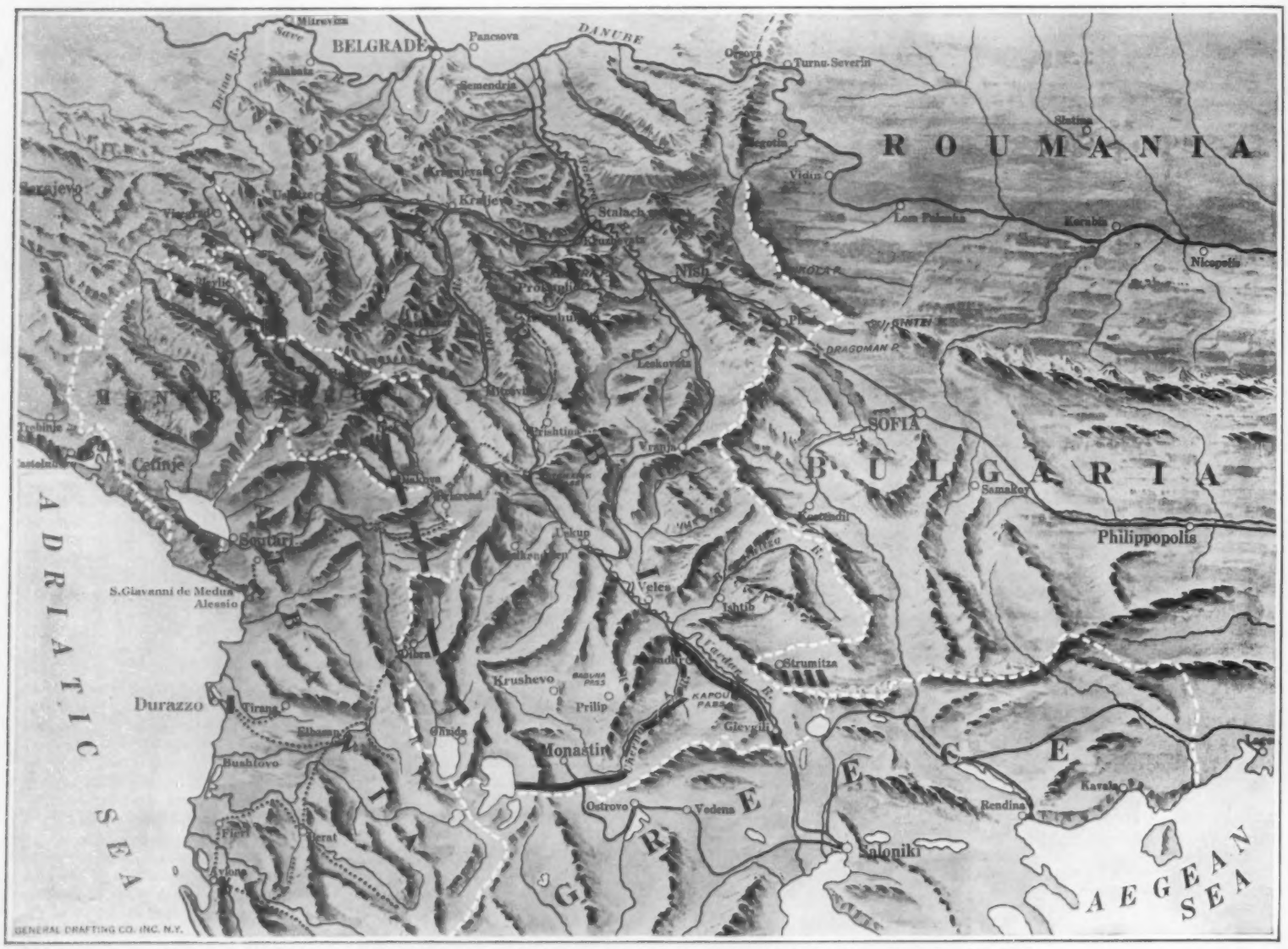
Reports, not confirmed at the moment these lines are written, declare that Italian forces have landed at Avalona to enter the Balkan campaign with the Entente allies, as well as at Durazzo.

Roadways, not of the best character, lead eastward from these towns, meeting at Elbasan, continuing around the southern end of a mountain range, through

A strong defensive position lies to the southward at the Demir Kapou pass. The gap is broad and is commanded from neighboring eminences. Already the Anglo-French forces have retired to this position, closely followed by the Bulgars, who are reported to be in possession of the railway station at this point.

There is strong probability that further retirement will be necessary against superior numbers and even that a political and diplomatic crisis will ensue, for the situation as reported indicates that the Entente forces may well be swept back to the Greek frontier and across it. The hand of the Greek King will be forced by the eventuality, and his country will probably declare definitely for one side or the other.

German, Austrian and Bulgarian troops appear to be engaged in this attack, a resultant of the occupation of Monastir and its sector and the removal of threat from that quarter. It is difficult to estimate the prob-



Map of the Balkans showing the approximate position of the fighting line in Serbia on December 8th, 1915

tively weak unit to be the more easily defeated by superior numbers and equipment.

Practically nothing of Serbia remains to the Serbians save a slender strip in the southeast, where such of King Peter's forces as have been able to extricate themselves from the Monastir-Okhrida line have, through Gievgili, joined the allied forces of the Entente on the Vardar-Cherna salient covering the Saloniki railway.

The invasion of Montenegro is well under way. The Teuton line extends from Jakova on the south to a point southwest of Plevlie, on the north. From Jakova the invading line drops almost straight southward into Albania, bending eastward a trifle at Dibra, toward Okhrida, another point of importance. The section between Okhrida and Monastir is in the hands of the Teutons, who are reported close to the Greek frontier.

Viewed as a whole, the advance through Montenegro and Albania appears to constitute an attempt at permanent occupation of those territories through to the Adriatic—a situation which cannot be passively permitted by Italy, to which country the control of this body of water is of national importance.

While movements of troops must be executed with the Rodonodza pass toward Okhrida. As this point, on the lake of the same name, marks the southern extremity of the Teutonic advance in this quarter, every indication points logically to it as an objective through which the Entente forces in Serbia may be aided.

Monastir marks the terminus of a branch railroad from Saloniki. While no reports have been published that the French are in position astride this line of communication, they would naturally be there in some strength, for the roads from the Albanian seaports over which Italian reinforcements must pass join the railway immediately south of the Greek frontier.

With the clearing of Serbia, the Teutons seem to have turned in force upon the Entente position at the confluence of the Vardar and Cherna rivers. The salient formed is a sharp one and is too exposed to be held without grave risk. A massing of Teutonic force is evidenced on the Vardar-Cherna salient. As the sides of any salient are strategic weaknesses, it would scarcely seem good policy for the Entente allies to merely hold on, for there is insufficient strength in their line to present any grave danger from the flanks to the attackers.

able strength of the forces engaged; but, eliminating possible Italian strength, it is believed that at least 100,000 Entente troops are in position on these lines. Concerned in the attack upon them, 40,000 Germans, 40,000 Austrians and 60,000 Bulgarian troops, a total of 140,000, is not considered an excessive estimate of force.

The very fact that a general offensive in this sector has developed lends color to the probability that Italy contemplates active entry into the Balkan turmoil. It properly indicates a desire to oust the defending forces before they can be materially strengthened.

The peculiar situation of neutrality in which Greece finds herself, with troops of the Entente permitted passage and basing on her soil, involves a question as to whether strong Entente forces will attack Bulgarian territory to the eastward of the Vardar and south of Strumitza, from Greek Macedonia. It is of speculative interest. A mountain range limns the frontier between Bulgaria and Greece, with the Struma river embracing it with prehensile branches. The railroad from Saloniki turns eastward at Akindshali and parallels the range, furnishing an excellent lateral line of

(*Concluded on page* 547)

The Transparent Aeroplane

By Neal A. Truslow

MILITARY authorities await the development of the new French invisible aeroplane with great interest. The French government is, naturally, very secretive about this invention, which bids fair to revolutionize aerial warfare, and information is difficult to obtain, but it is rumored that one of these machines recently attacked and destroyed a German Aviatik without a battle. The enemy craft had no intimation of the attack until under fire from the mitrailleuse of the French machine.

In type this new marvel is similar to the "Voisin." The body and framework are constructed, as in ordinary machines, of aluminum braced with wire. Over the framework, instead of canvas, is stretched a transparent material which looks like a cross between mica and celluloid. It is called "cellon," and is a chemical combination of cellulose and acetic acid. Of almost the same transparency as glass, it does not crack or splinter and has the toughness and pliability of rubber. It is neither inflammable nor soluble, and is impervious to the effects of gasoline.

Experiments with cellon have also been made extensively by the Germans, and for the same purpose, but without success because of a tendency to warp, which they were unable to overcome. The French success lies in having eliminated that tendency. And in doing so they have completed a practically invincible, as well as invisible, machine. At a height of 3,000 feet it becomes an indistinct blur. At 6,000 feet it is absolutely lost to sight. This means a great increase in scouting possibilities and less danger to operators. Since the aeroplane can be detected only by the noise of its engines, it is no longer a target for hostile guns.

The European war might well be called a War of Aircraft; and the opinion is growing that its issue will be decided by the birdmen. Almost every day sees new inventions or methods introduced to still further increase speed or power or efficiency. Last week it was the massive new German aeroplane, said to be propelled by four motors of 80 horse-power each, so heavy and unwieldy that the steering gear is of necessity operated by machinery, and able to carry 14 passengers at a speed hitherto unheard of.

This week has brought the still greater wonder—a machine that is invisible. In the hands of the daring French aviators great results may be expected, and the triumph of its production shows that the French have not been idle.

Standardization of Government Track-Scale Testing Equipment

REPRESENTATIVES of the United States Bureau of Standards recently standardized the large weights for the Bureau's test car No. 2, at St. Johnsbury, Vt., which has been built this year. It is said that the adjustment was accomplished with great precision, the probable error in the standardization of the total 90,000 pounds of large weights being put one tenth of a pound.

The weights of test car No. 1 were retested at the bureau to ascertain the change in weight that might have occurred during the past two years of service. This test disclosed the fact that the loss on the total 90,000 pounds of weights was but 1.2 pounds, an average of one tenth pound on each of the 12 weights. The weights are now having machine work done on them in order to provide a convenient method of sealing them.

French Coal Output in 1914

WITH the Germans occupying a good portion of the most important coal producing district of France, the figures for the coal output of French mines for 1914 evince a determined effort to work the mines that remain in the hands of the Republic to the fullest extent. The French coal production in 1914 amounted to 29,786,505 metric tons as compared to 40,843,618 tons in 1913. The coal output for the first half of 1914 amounted to more than half of the total production for the year 1913; the outbreak of hostilities and the occupation of the coal and iron district in northeastern France seriously affecting the output for the second half of 1914. In 1914 France imported from Great Britain 10,759,058 tons of coal, 18,883 tons of coke, and 116,549 tons of manufactured fuel.

Death of Carl A. R. Lundin

ON November 28th A. R. Lundin, of Cambridge, Mass., died suddenly of heart disease in his home in that city. He was 64 years of age.

Lundin was born in Venersborg, Sweden, on January 13th, 1851. For many years he was engaged in the most delicate part of the work in the construction of big telescopes by the Alvan Clark & Sons Corporation. He gained international fame as an optical expert, having made the objectives for the big telescopes at the Lick and Yerkes observatories, among many others.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Gas Lighter Than Hydrogen?

To the Editor of the SCIENTIFIC AMERICAN:

In your article on "Germany as Nature's Competitor" in the November 20th issue of the SCIENTIFIC AMERICAN, reference is made to the invention of a non-inflammable gas lighter than hydrogen for use in German airships.

In an article in *Collier's* that appeared in the summer of 1914, by Dr. K. A. Graves, on the "German War Machine," the author laid great stress on this wonderful invention which he claimed had several times the lifting power of hydrogen. The absurdity of such a claim may be readily demonstrated by a simple calculation.

Avogadro's law states that the volume of any gas bears a direct proportion to its molecular weight. Or the volume of a molecule of any gas is equal to the volume occupied by a molecule of any other gas at the same conditions of temperature and pressure.

Now, the volume occupied by 1 pound molecule of any gas at 62 deg. Fahr. and 30 inches Hg. press. is 380 cubic feet, or the volume occupied by 1 pound of any gas at this temperature and pressure is $\frac{380}{m}$ cubic feet, where "m" equals the molecular weight.

Furthermore, the lifting power of any gas per unit of volume is equal to the difference between the weight of this volume of air and the weight of the same volume of gas which displaces it.

Let us calculate the maximum lifting power of a weightless envelope containing 500,000 cubic feet of hydrogen at 62 deg. Fahr., 30 inches Hg.

$$\text{Weight of Air} \quad \frac{500{,}000 \times 28.95}{380} = 37{,}700 \text{ lbs.}$$

$$\text{Weight of Hydrogen} \quad \frac{560{,}000 \times 2}{380} = 2{,}630 \text{ lbs.}$$

35,070 lbs. net lifting power.

(Note: m—for air is 28.95 and for hydrogen 2.)

If the hydrogen could be replaced by a gas of zero weight the lifting power would only be increased by $\frac{2{,}630}{35{,}070} = 7.5$ per cent, a very small amount.

As it is also evident that the lifting power of any gas is proportional to $\frac{380}{28.95 - m}$ it is seen that a gas to have a lifting power greater than hydrogen must have a molecular weight less than 2.

To secure a non-inflammable gas having a lower molecular weight than this further complicates the problem, with no chance of even the ability of the German chemist securing its solution.

ALLEN C. STALEY, Ph. B., M. E.

Wabash, Ind.

"No Patent No Pay"

To the Editor of the SCIENTIFIC AMERICAN:

I have been interested in reading the article in the issue of November 13th on "No Patent No Pay," and recall a scheme described to me some years ago by an attorney who pretended to make preliminary examinations of inventions without charge. He told me that when a man submitted an invention to him he made no examination whatever of the patented art, but wrote the man he had examined his invention and was of the opinion that it was patentable and called on him for fees to file an application for patent. If the fee to proceed with application was received he told me he then proceeded at once to make an examination and if he found the invention to be anticipated he wrote the party that on taking up the case, as a measure of extra precaution, he had made a further examination and found the invention to be anticipated by certain patents, copies of which he sent, and he then made a charge for the copies supplied and wrote the party that he held the balance in his hands subject to order and would be glad to return it to the party.

This, he told me, did two things. It saved him making an examination in cases where parties did not proceed with the application and it also made the inventor think that he was not only a careful attorney but that he was an extra careful attorney who made the further examination to save the client the expense of a fruitless application. The mischief in this was not only the inconvenience it put the inventor to in forwarding funds for an application, but also the business inconvenience which might result to an inventor from attempting to market, on the basis of a favorable opinion as to patentability, an invention which he afterwards found was not patentable. It was, to say the least, an extremely unfair mode of dealing with a client.

A CONSTANT READER.

Washington, D. C.

Galveston During the Recent Storm

To the Editor of the SCIENTIFIC AMERICAN:

The exaggerated reports of the injury to the City of Galveston during the recent Texas coast storm were entirely unfounded, as there was little property damage, except to the fill immediately behind the seawall, which was absolutely uninjured and accomplished all that was expected of it.

The total death loss was eight persons and the only serious condition confronting the city at any time was the partial destruction of the county's causeway, upon which was one of the city's water mains.

All of the expensive archway construction of the causeway is intact and only that concrete portion of the structure which was filled with sand was injured and the concrete sheet piling was entirely undisturbed. The large volume of water rushing through the archway undermined the submerged duplicate water main which paralleled the causeway and approximately 800 feet of this was put out of commission, so the city was for a few days without water supply.

An ingenious experiment was made in inserting 20-inch dredging pipes into the broken ends of the 30-inch main and packing the space with ropes and oakum, and wedging with pine wedges. After the wedges were calked with shingles a small cofferdam of cement sacks was made under water and cut open from the inside, and the entire void filled with cement and then rammed by divers until the whole was like a mass of putty. After waiting 48 hours to allow the cement to set the water was turned on and the experiment was entirely successful.

The protective works of Galveston have justified the energy and thrift of her people in building a port whose foreign exports are exceeded only by New York city alone and which exceed ten per cent of the foreign exports of the entire United States. Conditions in Galveston are entirely normal, as evidenced by a comparison with August, 1914, wherein the August of 1915, in which month the storm visited the Texas coast, reflects greater bank clearings, larger pay rolls on the wharf front and a larger receipt of cotton.

You have evidenced in the past such an interest in the construction of the seawall, designed by General Roberts and Alfred Noble, also the filling of the city with over 15,000,000 cubic yards of sand, as well as the building of the great jetties by the United States Government, that I hope you can find space to refute the adverse reports condemning one of the greatest ports of this country.

GEORGE SEALY,

Second Vice-President of the Galveston Commercial Association.

Galveston, Texas.

Pipe Stems Bored by Larvæ

To the Editor of the SCIENTIFIC AMERICAN:

In your correspondence column, of November 27th, Mr. Hawley, of the Smithsonian Institution, asked for additional information on the boring in wood of long holes by larvæ and gives extract from Mr. Beede's letter on the Sioux Indians' use of larvæ taken from dead ash to drill their wooden pipe stems. I have on my desk a number of oak sticks about the right shape and length for pipe stems which have been bored lengthwise under my observation by the "oak pruner," or Elaphidion villosum. The twig is cut from the oak tree by the larva in the early autumn and falls to the ground, carrying the larva in the falling portion. The larva plugs the open end with shavings and lives until spring on the material which it cuts out of the twig. Usually, but not always, he cuts along the center of the twig and removes all the chips through a special opening in the bark at one point, so that the hole is clean from the plugged end to the opposite end at which he is working. We have even X-rayed him at work. These chips are all excrement of the larva. The shavings he makes for plugging the original first openings are clearly a special product. In the spring he emerges as a blackish, flying beetle, about ⅝ inch long, and soon deposits an egg in the green growing end of a small oak bough, where its presence kills the original small shoot and the larva later works backward and inside the wood to a larger branch, which he finally cuts from the tree at a point where it is usually between one half and one quarter inch diameter. The hole is oval and not far from ¼ inch diameter. Its length varies from 4 to 10 inches, in the cases I have seen.

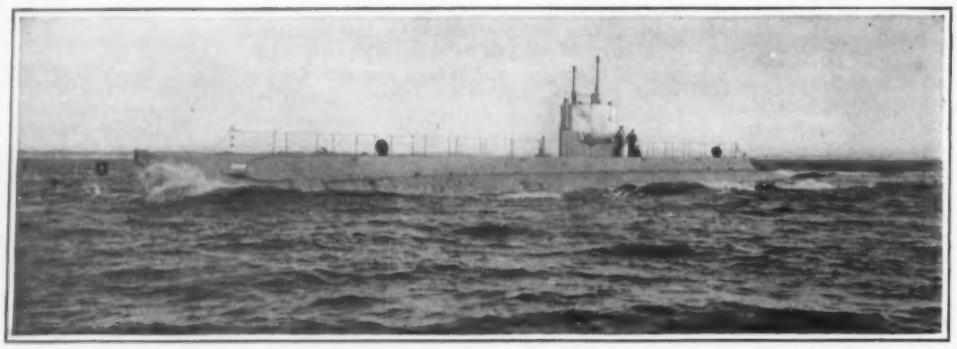
W. R. WHITNEY.

Schenectady, N. Y.

Submarine or Battleship—Which?

The Battleship—The Foundation and Supreme Fighting-Unit of a Modern Navy

THE battleship is the supreme fighting-unit of modern naval warfare. Whatever may be the numbers and wide range of activities of the lesser units, the final issue of a great naval campaign will be decided when the main battleship fleets line up against each other to fight it out to a finish in a line-of-battle engagement. If there is one great lesson more than another which has been taught by the present war, it is that the command of the seas will be held by that navy which possesses the superior force of capital ships (dreadnoughts and battle-cruisers). Thus far, it has been proved that the latest instruments of warfare, the submarine and the Zeppelin, have failed to wrest from the battleship its premier position; just as in a previous era, the battleship, when properly screened by scouts and destroyers, in spite of many predictions to the contrary, proved its superiority to the torpedo boat and the destroyer.



One of our latest submarines on her trial trip—a type too small for sustained sea service

Mr. Henry Ford, because of the fact that he foresaw and met the demand for a cheap car for the masses, and thereby graduated into the class of the multi-millionaire, believes that he is qualified to speak, *ex cathedra*, upon any military subject from naval construction to the settlement of the Great World war. He has told us that the defense of our coast can be accomplished by setting afloat on the seas a swarm of "mosquito" craft, of small size and of insignificant cost, which would have such terror for the enemy's battleships that they would never come near our shores, and, if they did, would quickly be blown out of existence.

Now, every naval man, and, thank Heaven, an ever-growing number of thoughtful laymen, know very well that all this kind of talk is the sheerest nonsense; but, unfortunately, there is an alarmingly large number of well-meaning people, both outside and inside of Congress, who are seriously infected with this "mosquito fleet" microbe; and they cling tenaciously to the idea that by means of the "baby submarine" or some other cheap kill-all device, American inventive genius is going to rush to the defense of the United States in its hour of pressing need and render vain all the "bloated armaments" of the foreign aggressor.

Fortunately, and thanks to the war-game played by the Atlantic fleet last fall on the western ocean, this coast-defense submarine idea has been put to a very thorough test and proved, so far as our present submarine fleet is concerned, to be wrong both in theory and practice. Therefore, we present the following facts for the very serious consideration of the country and of its representatives in Congress, upon whom rests the ultimate decision as to what kind of a system of naval defense the United States is to possess.

In this war game, the Atlantic fleet was divided into an attacking and a defending fleet. The attacking fleet was known to be approaching from the eastward for a descent upon the Atlantic coast. The defending fleet was more powerful in battleships and, if it could only locate and engage the enemy, it was presumably able to defeat him. The invading force possessed an adequate number of fast scouts, including a group of battle-cruisers; the defending fleet was so poorly supplied with scouts that, in the endeavor to cover the wide area of approach to our coast, it was necessary to utilize some slow colliers at the southern end of the scouting line and to string out a flotilla of submarines at its northern end.

It is with the amazing fortunes (or rather misfortunes) of the last-named vessels, that we are immediately concerned. These eight vessels, ranging in displacement from 350 to 520 tons, were ordered to rendezvous at Block Island and then make their way to a designated station, 75 miles south of Nantucket lightship, where they were to be strung out at intervals on a north-and-south line. In the choppy sea which was running, one of the largest of the craft at once developed poor steering qualities, rolled heavily, and made such bad weather of it that she was sent back to Block Island.

At 5 o'clock on the evening of the day following the arrival of the flotilla at the designated station, a radio was received from the Commander-in-Chief ordering the flotilla to move 125 miles southwest to a certain position, and it took between five or six hours to collect the flotilla and make a start at 10:30 that night for the new position. In spite of the fact that the weather was not rough but only moderate, the boats were so helpless in the seaway and developed so many defects that, by 5:30 the next morning, the flotilla had covered only 25 miles at an average speed of about 4 knots. Let it be noted here that the four largest of these craft, for certain structural reasons, were not able to operate more than one engine at a time. The flotilla commander, in view of the comparative helplessness of the little craft and the impossibility of reaching the designated station, ordered the submarines to deploy where they were, that is to say, 25 instead of 125 miles southwest from the position they had left the night before. Finally, by order of the Commander-in-Chief, the flotilla retired to Narragansett Bay, and, during this last leg of the course, the vessels made only 42 miles in eight and one half hours under way—and this, be it remembered, when the weather conditions were good.

Think of it—a speed of less than 5 miles per hour on the surface by boats which were designed to do from 13 to 14½ knots!

In view of this pitiful record of inefficiency, is it to be wondered at that there is a conviction throughout the Atlantic fleet that we should henceforth build only large sea-going and sea-keeping submarines of the type which has done such notable work for Germany—or build none at all? Obviously the 70 or so submarines, built or building, which we possess should be relegated at once to service in our harbors and roadsteads. If they venture out, they should remain at all times within easy reach of their base. Furthermore, the 70 boats referred to are sufficiently numerous, at least for the present, to perform harbor and coast defense duties.

It is true that three fleet submarines have been authorized—large vessels of somewhere around 1,000 tons displacement and high surface speed; but prudence would suggest that these vessels be considered as purely experimental. Until they have been tested out and a final well-approved design has been developed, we should call a halt on further submarine construction. We certainly do not want to repeat in the fleet submarines the pitiable failure of the non-seagoing, coastal submarines of the "K" type in the late war game.

In view of the above facts, the SCIENTIFIC AMERICAN

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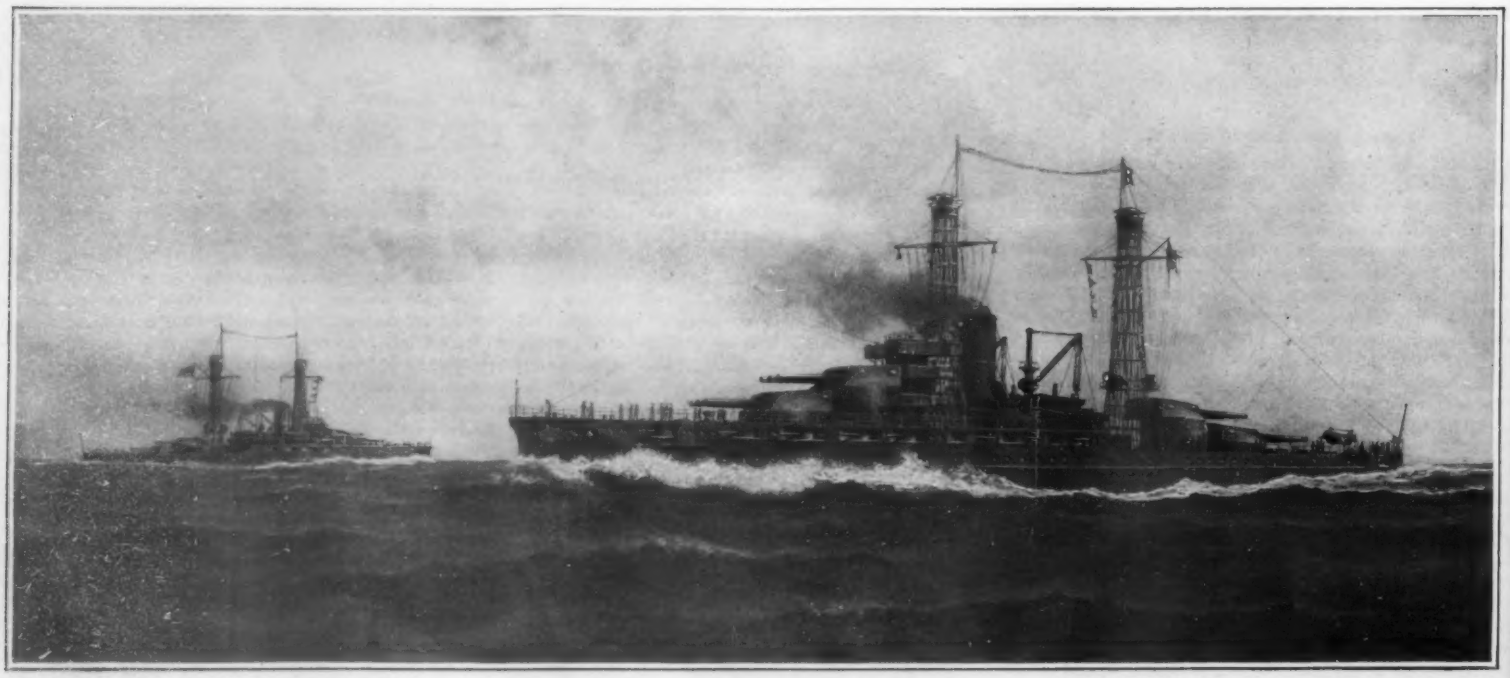
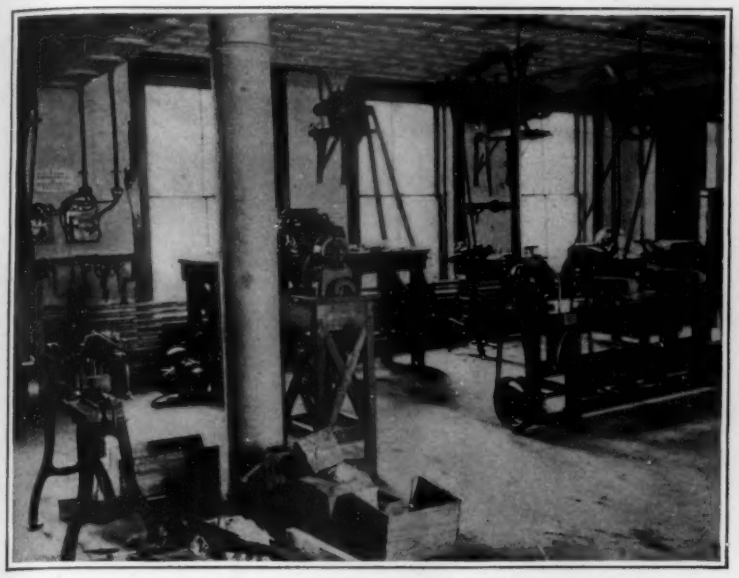
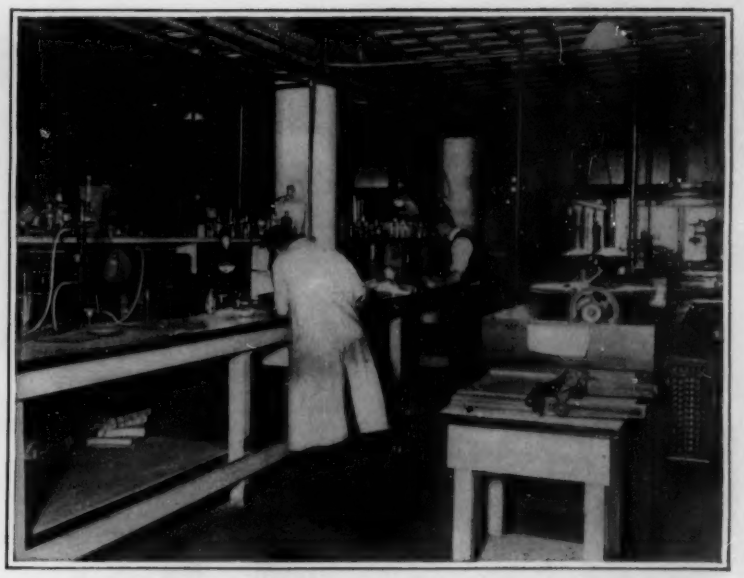


Displacement, 31,400 tons. *Speed*, 21 knots. *Armor:* belt, 13½ inches; gun position, 13½ to 18 inches. *Guns:* twelve 14 inch; twenty-four 5 inch.

Our latest dreadnoughts, Pennsylvania and Arizona



Metal-working machinery employed in preparing metal samples for analysis



Portion of the toxicological laboratory where many police samples are analyzed

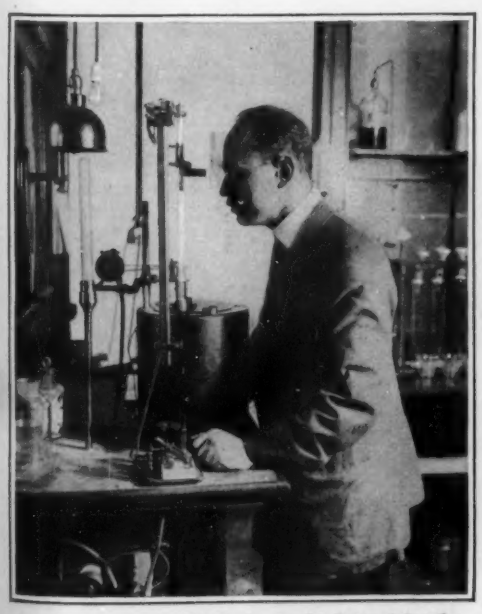
New York's Testing Laboratory

Describing the Varied Activities of a Municipal Testing Plant

As the purchaser of approximately $100,000,000 worth of supplies and constructional material each year, the city of New York, following the example of all large purchasers of raw and finished products, maintains a laboratory for the testing of its purchases. This laboratory is of particular interest not only because of its completeness, but also for the reason that the range of items to be tested is as diversified as it is great, varying from coal, metal and rubber hose, to hot-water bags, clinical thermometers, drugs and poisons of all kinds.

The Central Testing Laboratory of the City of New York, as it is officially termed, comes under the jurisdiction of the Board of Estimate and Apportionment, and occupies several floors in a building situated in the downtown section of the city. The duties of the laboratory are primarily the testing of municipal purchases, although a no little important part of the work is the analyzing of suspected drugs, medicines, beverages, poisons and other substances which are employed as evidence in court proceedings.

The Police Department of New York, upon seizing samples which are believed to be of incriminating nature, forward them to the Central Testing Laboratory. At the laboratory the samples are distributed among the chemists who are to conduct the tests, a most accurate checking system being employed to prevent samples from becoming lost or confused. Each chemist is provided with a large, numbered chest, in which he may keep the samples that have been turned over to him for analysis. The chests are provided with padlocks and individual keys, so that the contents cannot be tampered with.



Chemist using a bomb calorimeter for determining the heating value of a sample of coal

The analyzing of police samples requires the utmost care, for it is upon the findings of the laboratory staff that a suspected person is either freed or convicted. On the average, thirty cases a day are handled by the corps of chemists for the Police Department. Perhaps the greater part of the samples consists of substances suspected of containing narcotics, such as morphine, cocaine, heroin, and other opiates used by drug victims; substances of this nature being analyzed in the toxicological division of the laboratory.

Of peculiar interest are the police cases wherein drugs have been seized from persons suspected of engaging in illegal medical practice. The principal constituent of most illegal preparations, ergotin, cannot be positively identified by any known chemical means. But where present chemical knowledge fails, however, there has been enlisted the services of a rooster, which is constantly at hand. The suspected preparations are treated so as to form a solution, and are then injected into the rooster. If the comb of the animal subsequently turns dark, it is an indication that the injection contained ergotin.

No small number of police samples are beverages which, although labeled as soft drinks, are believed to contain alcohol. These are usually sent to the laboratory in their original bottles.

The order of sequence in handling the police samples methodically is facilitated by the use of a large board, which is divided into squares representing the different days of the month and the various courts of Greater New York. Small tickets, carrying a record of the police samples as well as the identification number of the chemist handling the work, are placed on pegs in the different squares, serving to indicate the time and place where the results of each analysis are to be presented as evidence for or against the defendants, as the case may be.

The testing of municipal purchases is by far the more important part of the work of the Central Testing Laboratory, although less dramatic in its meaning than the testing of police samples. However, the wide range of articles to be tested lends much interest to this, the predominant, rôle of the institution.

New York City purchases over 600,000 tons of coal each year, and not unlike the practice of other large purchasers of coal, the municipal authorities test samples of their purchases, for it is not the weight of the fuel only that determines whether full value is being received, but also the number of heat units contained in each pound. Samples of coal are taken from barges or cars and brought to the laboratory, where they are crushed and ground and otherwise prepared for the tests. The samples are tested by the conventional methods for the determination of their moisture, ash and sulphur content, as well as for their heating values. The huge quantity of coal purchased by the municipality in the course of a year necessitates the most complete equipment and a large personnel to handle this branch of the laboratory's work alone.

There has been set aside a room for bacteriological work. It has a transparent glass partition which extends to the ceiling. The chemist engaged in bacteriological research can lock himself up in the room so that he will not be disturbed, yet can see and be seen through the glass windows. In this part of the laboratory are tested disinfectants of all kinds, which are purchased by the city in large quantities. The tests are conducted with the object of determining the extent of destruction wrought on bacteria by a given amount of the disinfectant under test. Being completely isolated from the other parts of the laboratory floor, the chemist may conduct his work without possibility of serious errors through air infection.

In the same room which serves as the bacteriological laboratory there are also handled coroner cases wherein death is believed to have been caused by poison, the exact nature of which must be determined. It is not uncommon for the chemists to receive the stomach of a poison victim for analysis, and working inside the locked room the tests preclude any possibility of tampering, so that the findings of the chemist are indisputable evidence.

Paints, food products, explosives, asphalts, metal polishes, pest exterminators and hundreds of other products just as varied in nature are analyzed in the daily routine of the chemical division of the laboratory. The diversity of articles that are handled makes necessary the most complete equipment, and in some instances the chemists themselves have devised apparatus for facilitating the work where no adequate apparatus was to be had on the market. As a special instance, there has been developed by the staff a machine for testing asphalt, which has since been copied and adopted by other laboratories. Although there did exist

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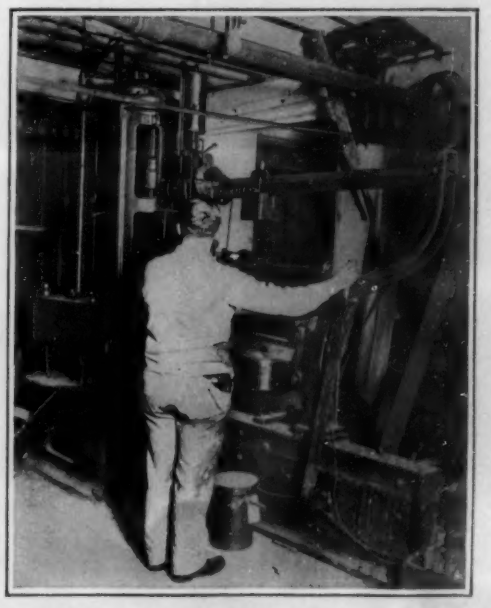

Machine used in testing the tensile strength of constructional materials of all kinds

Dog receiving an electric shock. The attitude of the animal depends upon its position when the circuit is completed. When the current is on the eyes are closed and the limbs rigid

Dog in the cabinet ready to receive the electric shock. The animal makes contact with the current by standing in a metal pan and wearing a flexible metal collar

Cat taken from a cabinet after being killed by an electric shock, the current having been applied for 30 seconds. The lid of the cabinet is opened by depressing the treadle on the floor with the foot

Killing Animals by Electricity

Humane and Efficacious, Offering a Striking Contrast to the Usual Primitive Methods

By Huntington Smith and William L. Puffer

[*The authors of this article write from intimate experience with their subject. Mr. Huntington Smith is managing director of the Animal Rescue League of Boston, Mass., while Mr. William L. Puffer is a consulting electrical engineer. The apparatus which was first installed at the headquarters of the Animal Rescue League in 1911 has since then been adopted by upwards of twenty cities and towns in the United States and Canada.*—Ed.]

ONLY those who have given some special attention to the subject realize what an enormous number of superfluous animals are destroyed in this country every year. In every city, town and village there are too many old and broken down horses still at work; too many ownerless and uncared for dogs; too many, far too many, cats. Add to these the animals that are decrepit, sick, or injured, and that owners wish to dispose of, and the aggregate is astounding. Two hundred and fifty-two humane societies in the United States reported last year that their agents had destroyed in the preceding year 480,848 small animals.

Granting that superfluous animals must be killed, the method by which they are killed is of prime importance. Poisons, the vapor of chloroform, carbon monoxide, illuminating gas, shooting, have been and are being used, and other means even less commendable. It is reported that, in at least one large city in the middle west, dogs at the municipal pound are slowly suffocated with the fumes of charcoal and sulphur. In a southern city, it is said, they are hanged with wires; in many places gas tanks are used. Whatever the method, under these primitive conditions the results have been deplorable. They have involved suffering to the animals destroyed and have endangered the lives and health and brutalized the men who were required to do the work. They are, moreover, unspeakably repulsive to every person of normal sympathies.

To provide for humane societies a really humane, safe, sanitary, and economical method for the destruction of animal life, it seemed obvious that electricity, properly controlled, would be the ideal agent. From the outset there was no difficulty whatever in killing animals by means of the electric current. It was quite another matter to devise a machine that would be automatic in action, that could be operated by any fairly intelligent workman, and that would not put a needless nervous strain on the operator or endanger his safety. The apparatus installed first at the headquarters of the Animal Rescue League in Boston, in 1911, and since then in upwards of twenty different cities and towns in this country and in Canada, has been used for the destruction of at least 150,000 animals, and has now been thoroughly standardized.

Because of radical differences in temperament and disposition, as well as of size, an entirely different type of apparatus was required for dogs and cats. The apparatus for killing dogs is a cabinet measuring about two feet six inches wide, six feet long and four feet six inches high. It stands on legs about a foot high, to bring the floor to a level convenient for the operator. The inner cabinet, which is electrically insulated, has at the bottom a metal pan. Above it, on either side, is a metal bar, from which hang strong spiral springs with snap hooks at the lower ends. The metal pan is connected to one pole of the high-tension circuit, and the metal rods to the other pole. Automatic contacts on the door control the low-tension current, so that when the door is open the current is switched off. In operation a flexible metal collar provided with suitable electrode points is put around the dog's neck, the end of a

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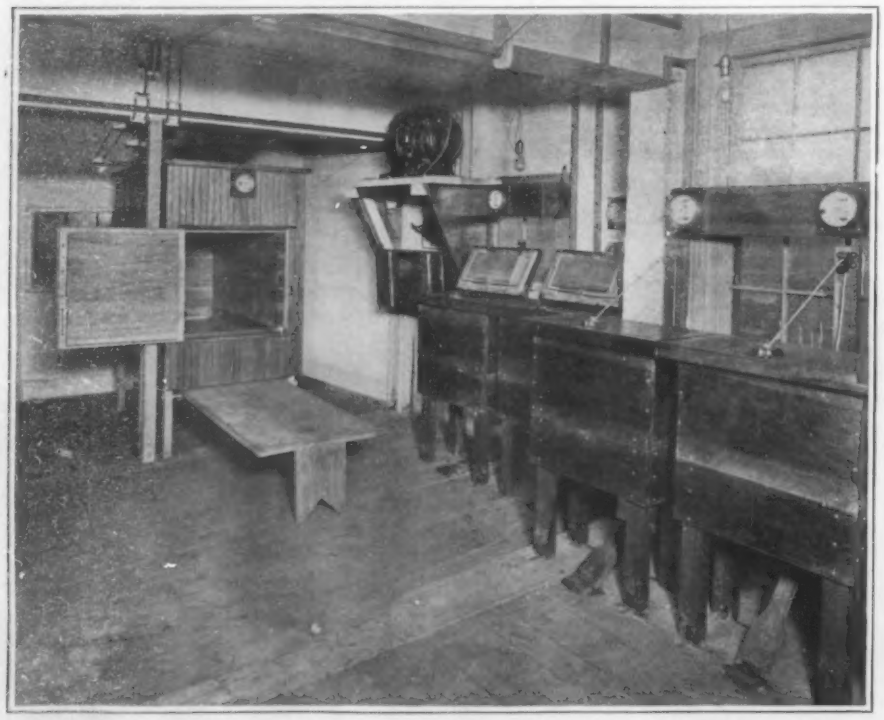


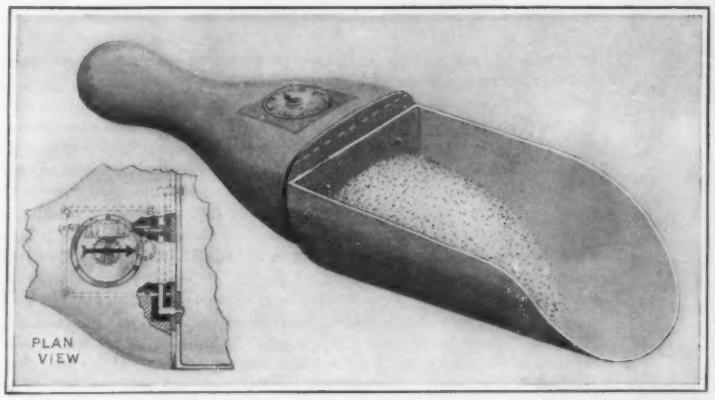
Apparatus for killing animals by electricity at the headquarters of the Animal Rescue League of Boston, Mass. At the left may be seen the cabinet for the electrocution of dogs. At the right are four cabinets for the killing of cats. With the equipment shown two men can easily destroy 300 animals an hour

Interior of electric stall at Pine Ridge Home of Rest for Horses, Dedham, Mass. The horse stands on a metal floor and is connected into the circuit by a chain hitch for a period of 12 to 60 seconds

Combination Scoop and Scale for Material in Bulk

WITH the object of introducing an implement that would at once be a scoop and a scale, thus comprising a labor-saving device, an inventor of Mobile, Ala., has recently perfected what he terms a "scoop-scale." This device, which is shown in the accompanying illustration, consists of a scoop of the conventional design, fitted with a large handle which contains a scale or weighing mechanism. In operation, the material to be weighed is scooped up in the usual manner. The scoop is then held in an almost vertical position so as to bring the weight of the contents of the scoop to bear on the scale. The weight is indicated on a dial conveniently located at the side of the handle.

By means of the new scoop it is possible to weigh goods at the bin containing the materials in bulk, and then place them directly into a bag. This is in marked contrast to the conventional method of using a scoop to pick up the material from the containing bin and carry it to a balance, requiring many steps and considerable time.



By combining both scooping and weighing operations in one, this device saves much time and labor

Time-Saving Rule Case for Newspaper Printers

A CINCINNATI inventor has recently devised a portable rule case which will be greatly appreciated by all printers, especially those having to do with the arranging of type into page forms. Already the device is being used in the make-up room of one of Cincinnati's largest newspapers and is proving itself a great time saver.

The new rule case is of compact size and so constructed that it may be readily attached to the end of a form chase, within easy reach of the printer who requires in his work of arranging the type into pages a variety of leads or rules of varying sizes. Heretofore, the practice has been to keep all rules and spacing leads on large racks in one part of the print shop. This necessitated many a trip for the printer between the form chase and the rule case, especially when rules of certain size were required in the work. In marked contrast, the new rule case is at all times next to the work so that the printer can select any sized rules without walking a single step. When one form has been completed and locked up, the rule case is detached and placed on the next form chase to be made up.

Much time is saved by the printer through the use of a portable rule case attached to the form chase

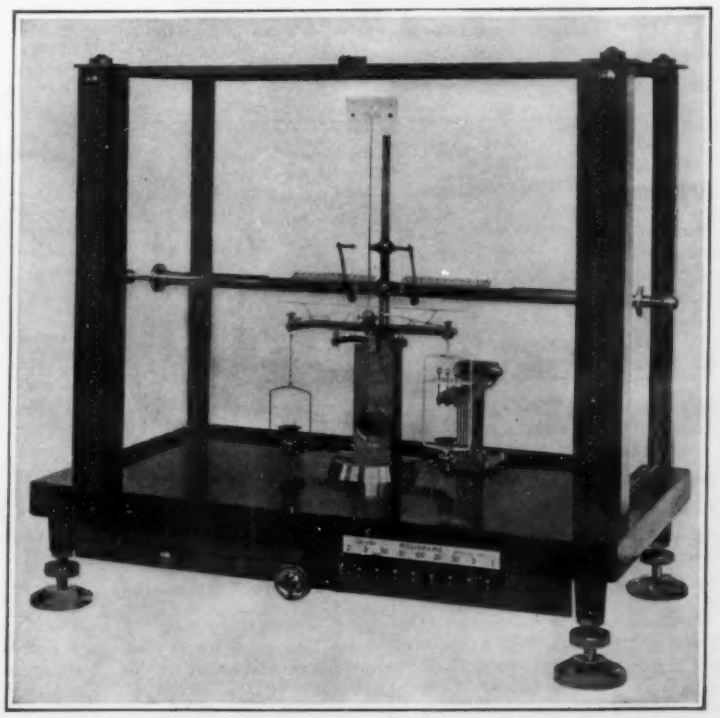
Keyboard-Operated Assay and Analytical Balances

REALIZING the time and labor that are consumed in operating assay and analytical balances of the conventional type, an inventor of Salt Lake City, Utah, has devised a balance which is operated from a keyboard placed in front and on the outside of the cabinet, serving to pick up and replace the necessary small weights. It is said that the balance has proved a great time saver in the West, where it has been introduced in the mining districts; a saving of 50 per cent in time being effected over the old style balances in many instances.

The mechanism of the new balance is simple in principle. The pan hanger on the right is fitted with a perforated grid or plate which serves to hold the weights. Upon the base plate, just behind the pan hanger, is placed a short column which carries nine movable levers. Mounted on the front of each lever is an upright, conically-shaped staff which moves centrally and vertically through the perforations of the plate previously mentioned. By means of keys placed on the outside of the cabinet, any one or any desired combination of the staffs can be brought into play.

The weights of the new balance are in the form of disks. Each disk has a perforation in its center, which serves to hold it on the conically-shaped staffs. When not in actual use the weights are supported on the staffs over and free of the grid or plate directly below them. When required they are deposited in the counter sunk holes of the grids by depressing the respective keys on the front of the cabinet.

The new balance has a capacity of 221 milligrams for assay uses with the weights of the following denominations: 1, 2, 3, 5, 10, 20, 30, 50 and 100 milligrams. Where the balance is to be used for exceedingly delicate work, the total capacity is limited to 110 milligrams. A rider is used to secure the intermediate variations of weight.



Analytical balance the weights of which may be adjusted by means of a convenient keyboard

Aside from the obvious convenience and saving in time effected through the use of the new balance, there is gained an equally important advantage, namely, that the weights used can be immediately and correctly noted by glancing at the figures appearing above the keyboard. The distinct figures render mistakes almost impossible as compared with the difficult reading of the figures stamped on the small weights in general use. Furthermore, it is possible to put on and remove the weights from the balance without opening the window, which feature tends to even greater accuracy since certain samples while being weighed often accumulate moisture if exposed too long to the air and thus tend towards inaccuracy in quantitative analyses. The weights may also be adjusted while the beam of the balance is swinging.

The Current Supplement

THE striking picture on the front page of the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2085, for December 18th, 1915, illustrates a clever artifice in naval operations that was originated by American officers, and which has been employed in at least one of the engagements in the North Sea. *The Improvement of High Boiling Petroleum Oils* describes a process by which the value of such oils is considerably increased. *Marine Mines* tells about the various kinds of floating mines that are employed for protecting harbors and channels, how they are planted and methods for destroying them, and there are a number of explanatory diagrams. How to *Increase Steam Production* is a paper of great value, as it describes seemingly revolutionary methods that have been adopted in some great steam power plants to solve the problem of a demand for more power. Engines have apparently reached their limit in improvement, and attention is now being directed to the boiler, with remarkable results. *How French Hospital Trains Help to Save the Wounded* is an interesting description of an important part played by the railroad in war. *The Tragedy of Tarawera* is a romantic story of a volcanic eruption in New Zealand, and is illustrated by some excellent pictures of the region in question. *The Diesel Engine* is a valuable survey of the evolution of this important source of power, as applied to marine purposes. Electric welding is an important technical process of recent development, the latest form of which is *Percussive Electric Welding*, a method that possesses great value for many special purposes. This process is here fully described, with a number of instructive illustrations. The article *On the Structure of the Universe* is concluded, and there are articles on *Micro Weighing* and other topics of interest.

Solving the American Potash Problem

SEVERAL new methods on increasing the supply of American potash have recently been brought to the attention of the Bureau of Foreign and Domestic Commerce. One of the most promising of these efforts to find a substitute for German fertilizers is presented in a patent taken out recently by a Canadian for a method of using the potash in ordinary feldspar.

The process is a simple one, consisting of heating the feldspar with limestone and iron oxide at a temperature of about 2,200 deg. Fahr., which produces a partly fused mass that is easily decomposed by a weak acid. From this product the potash salts can be extracted readily for further purification. The inventor has been in consultation with Dr. Norton, the expert who has been looking after the potash and dyestuff situations for the Bureau of Foreign and Domestic Commerce, and it appears likely that a greatly simplified method of transforming feldspar into fertilizer will soon be available.

A practical try-out for another method of obtaining potash fertilizer will soon take place at a New Orleans distillery where molasses is used in large quantities. It is a fact that 106 tons of potash are wasted daily by the 25 or more distilleries in the United States that subject molasses to processes of fermentation. The New Orleans company is planning to install the process of saving the potash in distillery waste recently brought to the attention of the public by the Bureau. It should be possible to make fertilizer from this otherwise worthless material at a price that will meet competition even after the war is over.

The Motor-driven Commercial Vehicle

Conducted by VICTOR W PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any questions relating to mechanical features, operation and management of commercial motor vehicles

The Six-Wheeled Truck

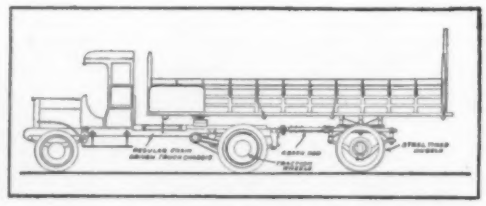
WHILE considerable difference of opinion exists among engineers and motor truck users relative to the advantages to be derived from the addition of trailers to carry an additional load besides that contained in the body of the truck all seem agreed about the effectiveness of that form of construction in which a six-wheeled motor vehicle is produced for transporting heavy loads. A vehicle of this type is shown in accompanying illustration and comprises a short wheel base motor truck chassis of standard construction which acts as a tractor and a large load carrying body or trailing member which is supported both from the truck chassis and the steel tired wheels at the rear. The trailing vehicle itself consists of two parts. The load is carried by an upper rotary bolster which rests upon the lower stationary member which is securely attached to the non-rotating trailer axle by three heavy springs. A reach rod connects the two parts of the unit, and as it is hinged at the rear of the tractor frame it insures that the trailer wheels will follow in the same lines as those of the tractor wheels, the proper turning angle being secured by adjusting the size of the supporting box. The turning radii of the trailer wheels are limited by two chains, these preventing a loss of alinement between the tractor and trailer wheels in event of there being an obstruction in the path. The bolster which carries the load rotates on a turntable arrangement and is connected with a lower bolster by means of a king bolt, as is used in the conventional horse drawn vehicle construction. It is said that the rotation possible between the rear bolster members compensates for much of the inclination that the rear wheels may have to run unsteadily over rough highways.

A trailer body of this type has marked advantages over the four-wheel form because it can be readily handled in traffic. Comparative figures between the cost of horse drawn haulage and that of the six-wheel truck shows conclusively that the latter is much more economical. In the contracting business many heavy materials are hauled and the loads may range as high as ten or twelve tons. There is a practical limit to the size of a motor truck and this, of course, has a corresponding effect in limiting the amount of load it can carry. The trailer construction of the type illustrated is much more popular with the contractors hauling heavy materials than it is with firms carrying on a general light trucking business. A New York firm that has kept a careful record states that a delivery from downtown New York to the Harlem section constitutes the working day for a team. The distance is from ten to twelve miles and the load carried by the horse drawn truck will seldom be more than five tons. With the trailer construction outlined it is possible to make three deliveries in the same day and carry thirty to thirty-six tons. If the trailer type of body is not used the same three deliveries could be made, but the capacity would be reduced to that of the truck of five tons per trip, which makes a total of fifteen tons a day. By the use of the body construction outlined it is possible to carry twice as much load without increasing the power of the five ton chassis used as a tractor. In other words, it is conceded that a given chassis is capable of transporting more material when used in connection with a trailer body than when used as a truck. This firm also reports that the trailer arrangement shown reduces wear and tear and that gasoline consumption is not much greater when hauling the heavier load than it would be if the truck chassis was provided with a body in the conventional manner and have its carrying capacity reduced to less than half of that made possible by the six-wheel construction.

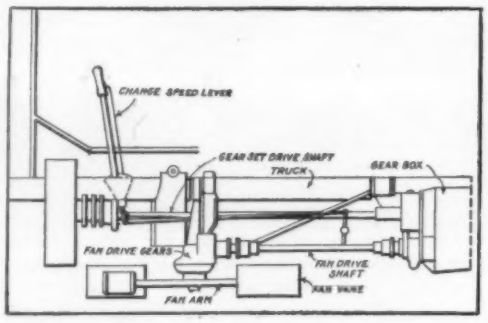
Air Brake for Motor Trucks

IT is not difficult to arrange for adequate braking capacity by using friction brakes of proper proportions so coupled to the leverage under the operator's control that they may be operated with but little expenditure of strength. This positive retardation is obtained only when all parts of the braking system are functioning properly; as soon as depreciation sets in from wearing of the brake members, or the friction is reduced from oil deposits, braking efficiency is impaired. Even water cooled brakes will depreciate and are not generally used because of the mechanical complication involved when they are applied.

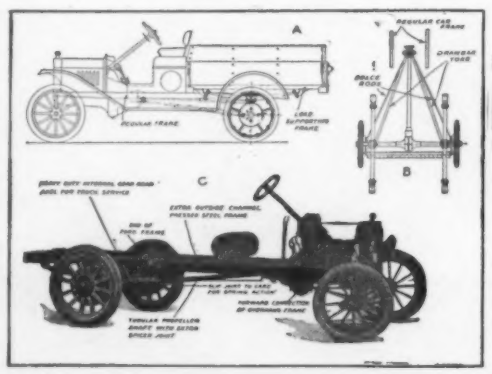
An ingenious application of the well known fan brake has been employed in Europe. This is intended to act through the transmission gearing of the truck. As shown in the engraving, this fan consists of two arms, diametrically opposed, which carry large rectangular blades or vanes near their extremities. The fan is so arranged that it may be connected to any desired gear ratio in the sliding gear box, so the amount of braking force available will depend upon the speed of rotation of the fan blades, which is a function of the vehicle speed and gear ratio engaged. The braking effect therefore increases as the gear ratio is lowered and is also effective even if the reverse gearing is engaged. Owing to the fact that the braking effect is not obtained by the rubbing of one surface on another, no heat can be generated or depreciation result because of the friction of solids. Any heating of the air is of little moment because fresh air constantly replaces that displaced by the fan. It is advanced that this device does not tend to raise dust when in use.



Six-wheeled motor truck. A combination vehicle which carries twice as much load as the conventional four-wheeled chassis of equal power would, without a corresponding increase in operating cost



Arrangement of the mechanism of a fan brake which operates through the transmission gearing



Methods of transforming a popular pleasure car chassis into one adapted to light trucking work

Converting Pleasure Cars Into Trucks

IT is but natural that attempts should be made to convert pleasure car chassis into light trucks and delivery wagons, and the more popular the car is the greater number one will find made over into commercial vehicles. As a rule this change is not one that is favored by the makers of the vehicle because no alteration is made to permit the chassis to carry the heavier body and load. With a view of adapting one of the most popular and widely sold of pleasure cars to commercial service, attachments have been devised to enable the purchaser to transform them to light trucks and at the same time make provision for supporting the heavier load. The methods of doing this are shown in the accompanying illustration. The side view at A shows the way the load supporting body is carried by the springs independent of those supporting the chassis frame. With this design the rear axle furnished by the maker of the car is used, but special attachments are provided in the form of specially designed wheels so that the load is carried directly by the special wheels, this relieving the rather lightly built chassis and rear axle of undue strain.

In order to have the vehicle carry a load worth while without altering the rear axle gear ratio special wheels are undergeared by planetary or epicyclic gearing so that the wheels may be driven at speeds ranging from twenty miles down to four miles per hour with the engine running at normal speeds and driving on the high gear. Gearing can be had therefore to fit the particular work the truck is to do. A special draw bar arrangement is employed to make sure that the draft will be distributed so that the regular car frame structure will not be stressed unduly. As the car in question is also provided with radius rods extending to a ball joint attached to the unit power plant the draw bar yoke members form a similar triangular shaped member, only their rear ends are joined to the spring pads for the load carrying body springs instead of to the rear axle brake drums as the regular radius rods are. This construction is clearly outlined in the plan view at B.

Another method of accomplishing the same end is by the use of a supplementary frame of heavy structural steel which is designed to fit right over the regular touring car frame in order to lengthen the wheel base. This supplemental frame, which is outlined at C, allows the designer to carry an internal gear driven rear axle equipped with solid rubber tires independently of the means provided for axle retention on the regular car frame. The frame and rear axle construction that are added are of sufficiently substantial design to permit of carrying much heavier loads than the pleasure car chassis would sustain unaided. Still other forms have been devised in which the rear axle of a car may be used as countershaft and attached to a fixed load carrying member. The drive is from spur pinions which are attached to the ends of live axle shafts instead of the rear hubs, these pinions driving the wheels by internal gearing. While the use of a pleasure car chassis of any description for commercial work is not advisable, at the same time the use of either of the methods outlined is much to be preferred over the usual practice of taking off the touring body and putting on a commercial type in its place. The devices are substantial in character and as they are intended for a car enjoying wide distribution they can be made up in an economical manner by the use of special jigs and tools and produced in large quantities and at reasonable prices on account of the large possible market.

Electric Starting and Lighting for Trucks

THE announcement recently made by a number of makers of light trucks that are to be furnished regularly with electric starting and lighting equipment has revived anew the discussion of whether the electric self-starter is really needed on the heavier motor vehicles. It is the writer's opinion that electric starting and lighting systems are just as logical for trucks as they are for pleasure cars, and as these have now been highly developed and simplified, the low initial cost and small maintenance expense have removed the last objection offered against this added refinement of motor truck construction. An observing motorist passing trucks in almost any large city will see that many drivers allow the motors to run even when the truck is at a standstill, and some permit the engine to run idle for a considerable period when making deliveries in order to be spared the exertion of starting the engine each time a stop must be made. It is not only because of the mechanical depreciation of the power plant through unnecessary running that this practice is condemned, but also because more gasoline and engine oil are consumed than if the engine is stopped. It is claimed that idling tends to promote carbon deposits, as the high vacuum produced draws oil past the piston rings and on the walls of the cylinder and the tops of the piston. After an extended period of idling the oil deposited on the piston top or in the combustion head burns up as soon as the load is applied to the engine. Part of this oil appears at the exhaust in the form of blue smoke, though considerable lubricant remains in the engine interior in the form of carbon.

(Concluded on page 545)

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Electric Starting and Lighting for Trucks

(*Concluded from page 544*)

With an electric starter of proper construction the driver will stop the engine entirely even when the vehicle is to make stops of short duration because the operation of starting the engine involves no exertion on his part. In the modern systems, the storage battery is kept constantly charged by a generator and much superior results are obtained because of the better lighting facilities enjoyed by the driver of an electrically equipped car. The bright head lights and dirigible or swivel spot lights permit the driver and helper to make faster deliveries after dark, which is a factor of some moment during the present season when the days are so short. If the car is equipped with a good light to drive by, better time can be made in surburban delivery work. Then, again, an easily manipulated auxiliary searchlight makes it easy to pick out street signs and the distinguishing numerals on the house fronts. It is much easier to install electric light in closed bodies than it is to carry a lighted oil lantern, as is often done on those forms not provided with an electric starter. This item is of considerable importance in all cases where the goods transported are of an inflammable nature. Distinct economy results not only by saving the time of the driver by starting the engine readily in either warm or cold weather, but the time saved by having brilliant illumination to promote faster driving and more rapid delivery work is equally important. The reduction in fuel, oil and repair expense due to carbon deposit should also receive consideration. As the power plants of trucks of large capacity have large size cylinders these engines are not as easy to start by hand cranking, so that the electric starter is a relatively inexpensive but positive insurance against broken arms due to back kicks or back fires and also reduces the element of fire risk in many lines of work.

Submarine or Battleship—Which?

(*Concluded from page 540*)

wishes to impress most strongly upon its readers the great cardinal fact that habitability at sea and a wide radius of action, both in the surface and submerged condition, are the indispensable prerequisites of the fleet submarine of the future. It should be able to go to sea, stay there for long periods of time, taking whatever may come in the way of bad weather, and house its crew with such a degree of comfort that, in the critical hour of attack, they shall be thoroughly efficient for their arduous and difficult duties.

The dreadnought battleship, then, as exemplified by those grand sister ships, the "Pennsylvania" and "Arizona," which we present in the accompanying illustration, is the supreme, sea-keeping, mobile, decisive fighting-unit of a modern navy. They are big enough to be unaffected by weather conditions and roomy and comfortable enough to maintain their officers and crew in such comfort that they will always be at the maximum of their efficiency. They have sufficient fuel capacity to operate thousands of miles from their base; they have sufficient speed when attended by their destroyer screen to be immune against destroyer and submarine attack, and when the supreme test of battle comes they can present the maximum of offensive and defensive power against the rival fleet of the enemy.

What is it that is to-day holding the 22 battleships and battle-cruisers of the second greatest navy in the world within its own ports and behind its own mine fields and netting? It is the presence, somewhere in the North Sea, of a superior force of battleships and battle-cruisers. Were it not for this, the German fleet would boldly issue forth, the submarines, destroyers and scouts of the enemy notwithstanding, and, before many hours had passed the British army in Flanders would be cut off from its base and the British Islands would be held tight in the grip of that very blockade which German submarines attempted but failed utterly to establish.

The gift that gets the Glad hand
CHRISTMAS CHEER
PRINCE ALBERT
CRIMP CUT
LONG BURNING PIPE AND CIGARETTE TOBACCO
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PRINCE ALBERT

the national joy smoke

YOU can go right up and down the line on gifts *and you won't strike one near the cost of this Prince Albert humidor* that wins such hearty appreciation!

For, a smoking-man gets a lot of home-happiness and office-happiness, and peace and contentment out of Prince Albert! It's so delightful in a pipe or rolled into a cigarette. *And that humidor,* with its sponge-moistener top, is a joy'us outfit for any man to call his own. Keeps the tobacco in such dandy trim!

And bear in mind, when you buy this humidor, that Prince Albert is made by *our own* patented process! That's why it's so good—*besides cutting out bite and parch!* He can smoke it all day and all evening—*it will not irritate his tongue!*

The Prince Albert pound crystal-glass humidor is the one great big universal all-joy-man-gift that's beyond a criticism—*the "Gift-that-Gets-the-Glad-Hand!"* P. A. is also sold in toppy red bags, 5c; tidy red tins, 10c; and in handsome pound and half-pound tin humidors.

R. J. REYNOLDS TOBACCO COMPANY
Winston-Salem, N. C.

New York's Testing Laboratory

(Concluded from page 541)

an apparatus for testing the hardness of asphalt at varying temperatures, it is said that it involved a slight percentage of error in operation which was incompatible with the high degree of accuracy sought by the municipal authorities.

In the testing of hospital supplies, perhaps the handling of clinical thermometers and hot water bags is of greatest interest. In the former instance the thermometers must be tested in the most expeditious yet accurate manner, for the municipality purchases for its numerous institutions upward of eighty gross of clinical thermometers each year, every one of which must be tested for accuracy before being accepted. The instruments are taken in batches of 100 at a time and placed in an electrically heated water bath. The water is available at four different temperatures, usually 96, 100, 104 and 108 deg. Fahr., the temperatures being determined by a standard instrument. After their removal from the bath the thermometers are read. A record is kept of each instrument, which is identified by the manufacturer's number marked in the glass so as to render impossible the resubmitting of rejected thermometers.

After the tests for accuracy, the thermometers are placed in a centrifugal machine which exerts an effect on them equivalent to a liberal number of shakedowns. The thermometers, held in suitable carriers, are spun around by hand power applied through speed-multiplying gearing. Thermometers failing to respond to this test are rejected.

In order to determine the wearing qualities of rubber hot-water bags a simple expedient has been adopted. The bags are filled twice a day with water heated to a temperature of 90 deg. Centigrade. The test is continued for a long period of time to determine the life of a given style of bag; the particular object sought being to ascertain the durability of the seams.

Paper and textiles are tested in a section of the laboratory set aside for the purpose. The equipment is standard and may be said to include the very latest machines, especially that for determining the folding capacity of a given sample of paper. Fabrics are tested for strength by being placed between two holding members spaced a specified distance apart. The textile is never cut in this laboratory: it is tested in the full piece, just as it comes off the bolt. By turning a wheel a pulling effect is exerted on the fabric held between two vise-like jaws, while the tension in pounds is noted on a large scale. A reading is taken at the moment of rupture. The textiles are always tested in two perpendicular directions—so as to obtain readings of strength both ways.

For the testing of the fastness of textile colors, as well as that of records made by typewriter ribbons and carbon papers, the samples are placed in an apparatus which exposes them to the action of ultra-violet rays emanating from a quartz lamp. It is said that these rays exert a bleaching effect on colors in a period of five hours equivalent to that requiring one week by the sun's rays. Flags in particular are tested in this apparatus to determine the fastness of the colors.

In the workshops on Blackwell's Island there has grown within recent years a clothing industry of no mean proportions. The municipality has accordingly been obliged to include a large quantity of thread in its yearly purchases for the use of the prisoner-tailors. The two requisites of thread for sewing machines are strength and smoothness. The rougher a thread is the more friction it is subjected to in passing through the mechanism of a sewing machine, and the more likely it is to break. Thus the aim in purchasing thread resolves itself into securing the strongest thread with the smoothest finish.

An ingenious little device which is attached to a conventional type sewing machine is employed for thread testing. Briefly, it may be described as two polished flat steel surfaces, between which passes the thread on its way from the spool to the sewing machine mechanism. The pressure between the steel faces can be varied by sliding a weight along a graduated beam. The thread in passing between the steel faces is tested for the two factors, smoothness and strength, at the same time.

Building materials of all kinds form an important part of the work of the laboratory. Iron and steel and certain alloys are subjected not only to chemical analysis, but also to microscopical examination. In the basement of the building housing the laboratory are two machines, one for testing the strength of ropes and cables, and the other for determining the strength of concrete blocks, iron and steel rods and other constructional supplies. The former machine has a capacity of 50,000 pounds, while the latter is rated at 200,000 pounds.

Killing Animals by Electricity

(Concluded from page 542)

spiral spring is hooked to the collar, and the dog is put inside the door, where he stands on the metal pan. The spring slides back and forth on the metal rod and gives the animal considerable freedom of movement. The instant the door is closed the animal receives the full force of the electric shock and becomes unconscious.

For cats and other small animals of a similar size, a cabinet is provided opening at the top. Metal electrodes are hung at either end of a slate tray. The low-tension current is controlled by automatic contacts on the cover, which is equipped with a cord, pulley and treadle, so that the operator can lift it by foot pressure, and thus have both hands free to manage the animal. Taking a cat in both hands, he places it in the box in such a way that the two forefeet of the animal are on one electrode and the two hind feet on the other. In this position the cat is perfectly comfortable and has plenty of light and air. The instant the cover is closed, the body of the animal is brought into the high-tension circuit and unconsciousness is instantaneous.

The time allowed for the destruction of life in the average cat is one minute, or twice the time given to the average dog. The difference may be due to the greater inherent vitality of the cat, to its organic resistance to the electric current, or, what is more probable, to differences in contact, owing to dryness of skin, fineness and density of fur, and so on. This element of time is apparently essential to death by the electric current, and experience would seem to indicate that there would be no material decrease in time if a much higher voltage or greater volume of current were provided. In no case, where measurements have been made, has the amount of electrical energy taken by the animal nearly approached the maximum available. As time increases, after the first application of current, the amount of energy taken gradually falls, as is shown by the two following examples:

DOG

(Mongrel Irish Terrier, 25 pounds)

Current applied for 30 seconds, beginning at 63 watts and falling steadily to 20 watts.

CAT

(9 pounds)

Current applied for 30 seconds, beginning at 83 watts and gradually dropping to 38 watts.

How do we know that death by electricity administered in this way is painless? We have, of course, the testimony of human beings who have been revived after electric shock and who invariably tell us that the suspension of consciousness has been absolutely without sensation. On this point Dr. William B. Cannon, a recognized authority on the subject as chairman of the medical branch of the Commission for the Investigation of Resuscitation from Electric Shock, after witnessing a full demonstration of the method, wrote as follows:

"With the voltage which you employ, and with the application of the current to neck and legs, the effect should be an instantaneous abolition of the functions of the nervous system. . . . The evidence that the current which you employ abolishes nervous action is that the nerve centers for respiration, which may be taken as an indicator for the other regions, are known to be thrown out of function by the current. Further, persons who are thus shocked are rendered unconscious and remain unconscious sometimes for more than an hour of artificial respiration, before consciousness and the ability to breathe are restored."

One very noteworthy feature is the peaceful appearance of the bodies of the animals after they have been subjected to the electrilethal process. Over and over again even experienced operators find it difficult to believe that life is actually extinct. The widely opened eyes are free from any expression of pain or fright, and the whole aspect bears testimony to the fact that death has been wholly devoid of any unpleasant sensation.

How does electricity kill? Frankly, we do not know. To us who have watched the operation hundreds of times, it seems as if all the vital functions were instantly held up, and being held up for a sufficient length of time, could not start again. With animals placed in connection with dry electrodes and without special preparation, the requirements of the electrilethal process appear to be, first, a sufficiently high voltage instantaneously to overcome fur, hair and skin resistance; second, the passage of a current sufficient, although small in quantity, to arrest and inhibit the vital functions; and, third, the prolongation of the period of inhibition by continuous current action, until automatic resuscitation is impossible.

Although the first trials were made with a voltage of from 4,000 to 5,000, and the instruments showed that from 400 to 500 were actually taken by the animal, no attempt whatever has been made to reduce the voltage to the minimum point. We have, however, demonstrated beyond all doubt that the amount of energy required to produce death under these conditions is astonishingly small, and that with a small current used in this way we approximate at the start the phenomenon of "electric sleep" and avoid all burning, mutilation, distortion, or other repulsive concomitants. We are convinced, also, that currents and potentials greatly in excess of those we have used would involve a waste of energy and lead to very unpleasant manifestations that should be avoided if possible. Although the initial cost of the apparatus is considerable, on account of the factors of safety, durability, and efficiency, the cost of maintenance is practically nothing, and the expense for current merely nominal. With current taken directly from a commercial lighting circuit, it has been found in practice that one kilowatt-hour of electrical energy is sufficient to kill from 800 to 1,000 animals. We have found that the most efficient and satisfactory results are obtained by the use of alternating current, and the apparatus can be used on any commercial alternating current outlet capable of supplying sufficient energy to operate an ordinary small-sized electric flat-iron.

Radio Inspectors and Their Work

(Concluded from page 537)

This instrument in the hands of the inspector enables the various elements desired to be speedily determined and the inspector to satisfy himself and his superiors that the equipment is in satisfactory order.

Notwithstanding the elaborate theory involved, in practice the inspection is a very simple affair. The inspector examines the apparatus to determine the length of the wave that it sends out, the nature of the wave, and that its logarithmic decrement as provided in the statute does not exceed two tenths. This means simply that the energy of the electric waves in an oscillatory circuit shall not decrease so rapidly that the range of transmission will be impaired, and that the amount of interference be reduced to a minimum. In other words, the logarithmic decrement so-called is a measure of the decay of a train of waves, and obviously this should be as small as possible and in a series of waves approach the condition of persistent oscillations. Thus a wave train with a logarithmic decrement of two tenths will have 24 complete oscillations before the amplitude of the last wave has decreased to one per cent of the first. Such a wave train is shown in the figure. For effective use at sea the wave form should be sharp and narrow, not broad unless it is desired to communicate with a large number of stations, as, for example, in sending a distress call. The inspector studies and records the nature of the wave sent out in each case, and may also recommend changes in the adjustment of the apparatus that will lead to a more effective arrangement.

Recently, one of the largest steamers in the coastwise service flying the United States flag was inspected in the presence of the writer, who was permitted by the courtesy of the local chief radio inspector to observe the operation.

The interior of the deck-house of the steamship "Pastores" of the United Fruit Company, in which the radio equipment is installed, is shown in the accompanying views. This vessel has two sets of wireless equipment, the more powerful set having a range of over 600 miles in day time. The larger set is operated from the main ship generator through a large motor generator in the engine-room of the vessel, but there are in addition an Edison storage battery and independent generator in the wireless-room, so that in an emergency, if everything but the upper deck were submerged, the generator could still operate the smaller wireless set, which has a range of some 400 miles.

The resonance curves appearing in one of the accompanying drawings were actually obtained by an inspector on a steamship visited a few weeks previous to the one seen by the writer, and depict the general method of work. From the reading of the decremeter the form of the wave was found to be as illustrated in curve *A*. In other words, instead of a sharp, pure wave wherein the logarithmic decrement did not exceed two tenths, there was found a broad one with two humps. Now with the receiving apparatus tuned, for example, to the second hump or the wave length of 562 meters there would be less efficiency than if it were tuned to the upper hump with a wave length of 542 meters. This curve being brought to the attention of the inspector of the operating company or the chief operator, the circuits of the transmitting system were re-tuned by varying the inductances and capacities so that a sharp wave was produced. Curve *B* represents the result of the second test, where the decrement is found to be .064 and the curve is sharp and regular as indicated. Such a curve stands for conditions that satisfy the law and regulations, and while it does not mean that the apparatus is any more useful in saving life, it does mean that the use of a sharp wave facilitates traffic and diminishes interference. With such a wave the receiving instrument can easily be put in tune with a transmitting apparatus, or if out of tune it will not respond. The broad wave, on the other hand, gives a maximum of interference, and consequently the law provides that "when sending distress signals the transmitter of a station on shipboard may be tuned in such a manner as to create the maximum of interference with a maximum of radiation."

The present scheme of inspecting wireless, both as regards the necessity of safety and the development of the art itself is working with apparently considerable satisfaction, and the coöperation of the various bureaus and departments generally of the Government has resulted in securing increased efficiency and preserving the conditions under which radio communication can be conducted, at least under peace conditions.

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The Gyroscope as a Ship Stabilizer

(*Concluded from page 533*)

combined with the confinement inside of an under-sea boat, is enough to wear out anyone but a man of iron, and the commanders of our squadrons have found that the personnel of the submarines are not of this order. No matter how perfect mechanically, the submarine is only as efficient as her crew.

Seasickness is no uncommon malady aboard men-of-war, and it takes some time for a sufferer to recover his accustomed vim, and he is not fit for strenuous work until he has done so. The purpose of naval transports is for the speedy moving of our sea soldiers from shore to shore. And it is most desirable that the men be landed in physical prime. A ship, then, that will have a miximum roll of not more than five deg. would contribute greatly to this desideratum, and, therefore, the gyroscopic stabilizer is to be placed aboard Transport No. 1. But this is only a step to bigger things. We may reasonably expect in the very near future to have the largest of our battle craft similarly steadied. With this done, our capital ships will be much better gun platforms. Not only will they be able to score oftener and at longer ranges with their great rifles, but, because the "spotters" will have less motion to contend with, it will be possible to keep the range-finder telescopes continually on the target. This will facilitate quicker and more accurate determination of the ranges.

But what will thus be done for fighting craft can, for another reason, be accomplished in behalf of the merchantship. It will be just as practicable to stabilize a big liner; and in this we see a promise of added comfort and the elimination of much misery for the ocean traveler. The active gyro as a stabilizer is infinitely more efficient than so-called anti-rolling tanks, because the latter, to become effective at all, require that the ship attain considerable lateral movement. On the other hand, the stabilizer of Mr. Sperry's devising deals with every disturbing impulse, be it big or little, and quenches its effect immediately.

Strategic Moves of the War

(*Concluded from page 538*)

communication for the shifting of forces behind the heights, while the broad valley of the Struma offers an enticing line of advance into Bulgaria. With the understanding, apparently, between Greece and the Entente powers existing that the forces of the latter may operate in Macedonia, it is highly probable that if sufficient forces become available and contributory conditions are favorable, operations in this section will develop; for success here would render the Strumitza position untenable and compel its prompt abandonment.

The contributory conditions in question seem to simmer down to the development of Russian action combined with material reinforcement by France, England and Italy. To be effective, Russian invasion of Bulgaria must come through Roumania, as it is highly improbable that sufficient shipping and naval force can be gathered on the Black Sea to not only force a point of entry into Bulgaria from the water, but land adequate forces and maintain supply service to the bases as well, necessary to the prosecution of a strong campaign.

That Roumania is expected to act soon seems evidenced by the massing of Teutons and Bulgars at important points along the Danube. Rustchuk, with its important railway center, being nearer to Russia than any of the other railway towns on the frontier, seems to have been strongly occupied, and in the event of Roumanian action will probably constitute the first point of attack. Svistowa, Nikopolis and Besli, other Bulgar towns at or near railways on the Danube frontier of Roumania and Bulgaria, are garrisoned in anticipation of some such emergency.

From a military standpoint it is not difficult to comprehend Roumania's reluctance to declare herself actively for the Entente, even though her people seem to be sympathetically inclined toward that cause. Her geographical position is such that three quarters of her frontier is ex-

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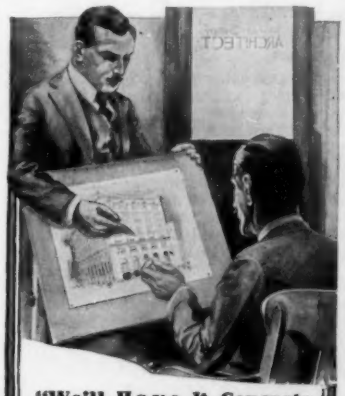

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posed to attack from Austria, Bulgaria and occupied Serbia. The lesson of the latter's annihilation is not lost upon those Roumanians who fear a similar fate for their homeland.

The Roumanian terrain is more favorable to military operations than that of any other Balkan state.

To begin with, the country is not a jumble of intersecting mountain ranges; it is comparatively open. Secondly, the Roumanian railway system is much more extensive than that of any neighboring state. There are five lines running approximately north and south, while an east-and-west railway for lateral communications practically bisects the country. Roumania should be able to place at least 500,000 troops afield. Supplemented by an equal number from Russia, the country should be reasonably secure. Possibilities for the severance of communications between Turkey and Teutonia and, if successful, for the fall of Turkey would be created.

There has been agitation in England favoring the abandonment of the Serbian campaign, on the plea that such assistance as has been rendered came too late. It would seem, however, that with deadlock and apathy existing on other fronts, there is a chance of success if the Entente action be coördinated by simultaneous action of Russia and Roumania on the north, strong Italian forces in Montenegro and Albania, with operations by the present Entente troops in Serbia rendered effective by ample augmentation.

There is no intent to indulge in mere speculation; there must be a reason for the French-English-Serbian clinging to the Saloniki railway with comparatively slender forces, other than the mere privilege of fighting; there must already have been some plan of operation determined upon if Roumania and the Entente come to terms. The way outlined above appears to be the one most probable of inauguration.

NEW BOOKS, ETC.

SOMETHING ABOUT "606" (SALVARSAN) AND "914" (NEO-SALVARSAN). By A. O. Zwick, B.S., B.A., M.D. Columbus, Ohio: The Midland Publishing Company. 8vo.; 25 pp.; illustrated. Price, 50 cents.

These re-printed articles describe Ehrlich's remedies for syphilis, giving their peculiarities, their formulæ, and their structures, and offering some statistics as to their efficacy and a warning relating to the conditions under which their employment may be dangerous. The later remedy, the author claims, is of at least equal efficacy with the earlier, is more easily tolerated, is less painful in intramuscular injections, and is readily soluble in cold water, which greatly simplifies its preparation and results in a completely neutral solution.

MODERN INVENTIONS. By V. E. Johnson, M.A. New York: Frederick A. Stokes Company. 8vo.; 320 pp.; illustrated. Price, $1.50, net.

ENGINEERING. By Gordon D. Knox. New York: Frederick A. Stokes Company. 8vo.; 276 pp.; illustrated. Price, $1.50, net.

The wonders of the age in which we live are fascinatingly described in these two volumes of the "Romance and Reality" series. In "Modern Inventions" the triumphs of the last quarter of a century in the realm of invention are catalogued. The moving picture, the submarine and aircraft, sun-motors and electroculture—these subject headings will serve to indicate the material handled. In "Engineering" we learn all about the arduous labors of the canal builder, the irrigation engineer, the railway constructor, and the miner. The volumes have frontispieces in color, with a wealth of illustration in half-tone plates and line drawings. Both authors have done much good work in the field of popularized science, and both bring to their latest effort a ripeness of experience that has not failed to result in animated and instructive reading.

STAR AND WEATHER GOSSIP. Concerning the Heavens, the Atmosphere, the Sea. By Joseph H. Elgie, F.R.A.S., M.B.A.A. Published by the Author, 24 St. Michael's Road, London, S.W. 1915. 12mo.; 190 pp. Price 2s. 6d. net.

Wind and sea, fog, frost, and stars, are the elements that combine, resolve, and re-combine in new proportions throughout Prof. Elgie's sympathetic musings. A side light on Shakespeare, a glance at Mars and the researches of Dr. Lowell, a prose poem of the North Sea in angry mood—such fragments as these indicate the gossipy style of the little work, which emphasizes nature rather than science and concerns itself more with emotion than with mensuration; it is the meditative expression of a nature-lover, designed rather to create a thirst for knowledge than itself to satisfy that thirst.

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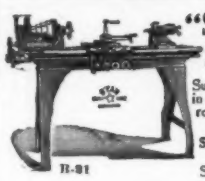

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